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ABSTRACT

The vocational reading demands of the plumbing trade were investigated to compare the curricular reading demands encountered by apprentices in the educational setting and the occupational reading demands encountered by journeymen in the actual job situation. A secondary purpose of the study was to examine the role and treatment of reading, as both an educational tool and a vocational skill, in the education/apprenticeship situation. Subjects included members of a fourth-year apprenticeship class who were in the final stages of training before becoming journeyman plumbers and five journeyman plumbers selected at random. Data were gathered through interviews with and observations of plumbing students and incumbents, in a four-part process using interrelated instruments and procedures. Three conclusions were drawn from the findings: (1) the curricular and occupational reading demands of the plumbing trade are different in terms of the variety, complexity, frequency, perceived importance, general and specific strategies, and time involved; (2) the vocational reading demands appear to be extensive and diverse; and (3) reading is only minimally treated as a concern in the educational setting and some minor reading-related problems do exist. (Among the numerous appendixes are attitude questionnaires, task checksheets, observation records, and assessments of reading material difficulty.) An extensive reference list is also included. (HOD)

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THE UNIVERSITY OF CALGARY

AN INVESTIGATION OF THE CURRICULAR AND OCCUPATIONAL READING DEMANDS OF THE PLUMBING TRADE

by

KATHRYN L. CHANG

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
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DEGREE OF MASTER OF ARTS

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FACULTY OF GRADUATE STUDIES

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ABSTRACT

This study was an investigation of the vocational reading demands of the plumbing trade. The primary purpose was to compare the curricular reading demands encountered by apprentices in the educational setting and the occupational reading demands encountered by journeymen in the actual job incumbency situation. Reading demands were operatively defined as a composite of the variety, frequency, complexity, perceived importance, general strategy (purpose), specific strategy (process), and difficulty of the reading tasks encountered. Considered, as well, was the significance of reading in terms of time involved, use of alternative strategies and attitude of the reader. The secondary purpose of the study was to examine the role and treatment of reading, as both an educational tool and a vocational skill, in the educational/apprenticeship situation. Data was gathered through interviews with and observation of plumbing students and incumbents; the gathering of data was a four-part process using inter-related instruments and procedures.

Observations were examined in the light of four separate, yet inter-related academic fields: technical/vocational education, functional/occupational literacy, content area/functional reading instruction, and readability assessment. Studies in technical/vocational education indicated that reading, as a vocational skill, should be addressed within the job training component, but that numerous reading-related problems exist in occupational education. Research in the area of functional literacy had determined reading to be an important vocational skill, and had provided methodologies for attempting to ascertain the reading demands of a given occupation. Investigations in content area reading provided a rationale and methodology for functional instruction of reading. Finally, research in the field of readbility assessment indicated the complexity of matching reading materials to the needs and abilities of the intended users.

From the study, there were three significant conclusions. First, the curricular and occupational reading demands of the plumbing trade are different in terms of the variety, complexity, frequency, perceived importance, general and specific strategies, and time involved. Second, the vocational reading demands appear to be extensive and diverse; reading is an important vocational skill in the plumbing trade. Third, reading is only minimally treated as a concern in the educational setting and some minor reading-related problems do exist. From the observations and conclusions of the study, implications were drawn for the role and treatment of reading in the curricular setting.

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Dedicated to

Walt, Cary and Marlise,
Mom and Dad

whose love makes dreams
into reality

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CHAPTER ONE

INTRODUCTION

PURPOSES OF THE STUDY

This study was an investigation of the vocational reading demands of the plumbing trade. The primary purpose was to compare the "curricular" reading demands encountered by apprentices in the educational situation, and the "occupational" reading demands encountered by journeymen in the actual job incumbency situation. In order to do so, the reading demands of each job component were first determined, through interviews with and observation of plumbing apprentices and journeymen. For this study, "reading demands" meant a composite of the variety, complexity, frequency, perceived importance and difficulty of reading tasks encountered, and the strategies involved between reader and materials. "Variety" was the list of tasks actually encountered; "complexity" referred to the format of a reading task; "frequency" was the number of times the task was completed; "importance" referred to the significance of the reading task to successful job completion; "difficulty" was both an approximate reading grade level and the reading skill level demanded by the material relative to the reader's competence. "Strategies" were the purposes and processes readers used with reading materials to complete a task (Sticht, 1977); reading tasks were categorized into one of four general strategies (Diehl, 1980): "reading-to-learn," "reading-to-do with no learning," "reading-to-do with incidental learning," and "reading-to-assess." These four general categories or purposes were further divided into fifteen specific strategies or processes. Once the reading demands had been determined for each job component, similarities and differences between components were discerned.

The secondary purpose of the study was to examine the role and treatment of reading, as both an educational tool and a vocational skill, in the educational/apprenticeship situation. Implications for reading within the curricular setting were drawn from the comparison of curricular and occupational reading demands. As well, examined in the light of the concern for functional/occupational literacy, content area reading instruction, and reading within technical/vocational education, some reading-related issues and problems became apparent.

RATIONALE

This study was concerned with the reading demands encountered by professional plumbers, ie. those who, through formal vocational education and subsequent formal certification, qualify as skilled tradesmen. According to the Apprenticeship and Trades Certification Branch of Alberta Advanced Education and Manpower, a journeyman plumber must undergo four years as an apprentice and/or pass the trade certification examination. The entrance qualification to plumbing apprenticeship programs is the successful completion of a trades entrance examination. Thereafter, the plumbing apprentice works for four years as a full-time employee (minimum 1600 hours per year) under the supervision of a journeyman plumber, and must attend a formalized training program for eight weeks per year. The professional plumber progresses through five stages or levels of career advancement: first, second, third and fourth year apprentice, then journeyman. Therefore, up to the level of certified journeyman, the job of plumber involves both a job incumbency situation and an educational/training situation. A basic premise was that both situations involved the reading of print material. The focus of this study, then, was the curricular and occupational reading that together comprise the vocational reading demands of the plumbing trade.

The skills necessary for successful job completion are imparted to prospective tradespeople, presumably, in the training program (Thornton, 1979). Although manual skills may be given precedence in trades training, reading has been determined to be an important occupational skill (Diehl, 1980; Murphy, 1975; Sharon, 1973; Sticht et al., 1971, 1972, 1975, 1977, 1978). Thus, reading is also an essential occupational skill worthy of instructional consideration (Lee, 1981; Thornton, 1979). Ideally, job training should include preparation for the reading demands on the job (Seifert, 1979); and in the case of the skilled trades, the "job" has two components. Therefore, the entire range of skills, including reading, required to successfully complete formal training are as much job-related as those performed in an employment environment. However, the reading demands of the educational component may be different from those of the incumbency component, in terms of the cognitive demands, the availability of extra-linguistic cues, the uses of information gained, and the nature and frequency of the tasks encountered (Diehl & Mikulecky, 1980, Mikulecky, 1981; Moe, 1979; Ross, 1980; Sticht, 1978). Data gathered by Mikulecky (1981) suggests that workers face more stringent literacy demands on the job than students currently face in school; on the average, students from both technical and high schools read less in school than they will be expected to on the job. Conversely, Sticht (1978) found that reading demands for job preparation were much greater than for job performance; curricular reading demands involve reading to form and retain new concepts, as opposed to occupational reading to look up specific information for relatively immediate use. Regardless of which situation poses the most difficult demands, it appears that they may be different. For this reason, curricular reading and occupational reading should be separate concerns of the trades training program, and both should be addressed.

In reality, it appears that neither curricular reading nor occupational reading are addressed in many vocational education programs, and that reading-related problems do exist. To begin with, reading skill is treated as a prerequisite to entry to vocational programs; students are supposed to read at a specified grade level as a minimum entrance requirement to many programs. It is assumed that students are able to read the textbooks, notes, examinations, and other curricular materials to achieve success in an educational program, an assumption with apparently no basis in fact (Thornton, 1980). Perhaps for this reason and others, the majority of American technical and vocational institutions make no provision for either general reading and study skills or occupation-specific reading skills (Thornton, 1980). In a thorough examination of the literature in the Dialog Data Bases concerning reading in post-secondary occupational education, Thornton (1980) found that there was practically no reference to occupation-specific reading skill development, and that if reading was treated at all, it was as a curricular issue. Thornton (1979) hypothesized that reading has not been an instructional component of vocational education because many vocational educators erroneously believe that: 1) reading is a function of general education, not a responsibility of the vocational teacher; 2) teaching reading and reading remediation are specialized areas of instruction, beyond the capability of the occupational instructor; 3) reading inabilities are overcome by psycho-motor skill and by excellence in manual dexterity; 4) vocational students are not interested in reading about their subjects, only in performing the skills; 5) reading belongs elsewhere in the academic structure, time has not been provided for it in occupational education; 6) the source of knowledge about an occupation is in performance and supervision not in literature about it; 7) the limited amount of literature in an occupational specialty is easily read and understood; 8) classroom reading can be circumvented by avoidance of textbooks and substitution of descriptive handouts; and 9) if a diagnostic score indicates low student reading ability, the student is unable to read content literature and needs reading remediation or the problem circumvented by emphasis on physical skills. To this may be added the fact that literacy is not requisite for functional competency; reading skill is but one of the cognitive competencies needed for successful job completion and societal functioning. Although the inability to read might be an impediment to advancement and independence, it does not ensure unemployment. Based on these notions about reading, many vocational programs make no provision for either general reading/study skills or occupation-specific reading skills. However, there have been widespread complaints from business, industry, the military and the general public that increasing numbers of workers are inadequately prepared for work (Copperman, 1978; Diehl & Mikulecky, 1980; Horne, 1979; Hymowitz, 1981; Jacob & Crandall, 1979; Ross, 1980); there are further complaints that significant numbers of adults do not have sufficient reading skills to function in occupational situations (Gadway & Wilson, 1975, Louis et al., 1970; Murphy, 1975; Northcutt, 1975). Until recently, reading-related problems have apparently been obscured or ignored in occupational education.

Technical and vocational education programs are rife with potential reading-related problem areas. To begin with, the technical language peculiar to a trade may be complex and difficult to learn (Lee, 1981). Trade-related literature may be of a wide range of difficulty according to the task; the amount of technical language, trades language, and lay description; the use of diagram and illustration, and the attendant language to diagram ratio (Thornton, 1979). Textbooks and technical manuals often have a very high reading level due to the technical language and the necessity for accuracy before readability (Thornton, 1979). There is evidence to suggest that the readability level of many curricular materials is not commensurate with the reading ability level of the intended users (Thornton, 1980). Related to that are the problems examinations may present. The claim was made by Hunt and Lindley (1977) that pre-employment tests are often too hard to read; applicants must contend with unnecessary and irrelevant reading demands before they can meet and solve the problems on the job (Mikulecky & Diehl, 1979). As well, tests are usually given in settings which deprive the individual of access to other cues or sources of information that they might consult on the job in accomplishing job tasks (Jacob and Crandall, 1979). Too, job training achievement is usually measured by traditional reading-to-learn tasks while actual job performance consists of reading-to-do (Sticht, 1978). A third potential problem arises from the type of students who are typically drawn to industrial education: many are lower ability students who have a negative attitude toward reading (Lee, 1981; Thornton, 1979). There is likely to be a higher incidence of the type of student-related reading problems found in any subject-area classroom: inadequate concept development, insufficient language proficiency, deficient textbook/study skills (Vacca, 1981). Further complications arise from the fact most vocational educators lack the background to deal with reading as either a curricular issue or an occupational skill (Lee, 1981). Many occupational instructors emerge from their specialty, often have less academic and teacher education background, and are hired because of the ability to translate a specialty into job skills (Thornton, 1979). The most significant problem seems to be that not enough is known about the specific reading demands of most occupations to prepare individuals while in the training process (Auten, 1980; Horne, 1979; Jacob & Crandall, 1979; Sticht, 1978; Thornton, 1979). The solution to vocational reading problems seems to be to first identify the literacy demands of a given occupation, and then to incorporate specific and relevant skill development into the training/educational situation.

Some effort has been directed at identifying vocational literacy demands. Sticht and his colleagues at the Human Resources Research Project have designed many projects to identify the literacy requirements of Army jobs, techniques for reducing those demands, and methods for improving the reading skills of military personnel. Mockovac (1974) did similar research with Air Force personnel; Spicer (1975) examined the communication competencies required by business and professional persons; Heinemann (1979) and Ross (1980) studied the job-related performance tasks of secretaries; Moe, Rush and Storlie (1979) attempted to identify the specific literacy skills required in ten occupations, on the job and in the training program; Smith researched generic skills for occupational training; Diehl (1980) examined the general nature of on-the-job literacy tasks, the difficulty of job materials, the relationship between that difficulty and an individual's reading ability, the relationship between literacy and job success, and the characteristics of competent and non-competent readers. As well, general job analyses have been done by many large businesses and are found in various occupational handbooks. Projects have also been directed at vocational/technical curriculum development: Farning and Boyce (1976) attempted to develop and verify a list of competencies for the communication skills area in vocational/technical post-secondary education; Howell (1976) identified the competencies in English needed by vocational students preparing for trade and industrial occupations in community colleges and technical institutes in North Carolina; Horne (1979) investigated implications of functional job literacy research for instruction.

However, the generalizability and usability of much of the above effort is affected by natural limitations and by questionable methodologies. It has been pointed out that research done in the military environment may not be generalizable to civilian situations, because the military may differ markedly from civilian workplaces in speed of training, in hiring and promotion policies and criteria, in the number of years experience workers have at a given job, and in the relative age and background of workers (Diehl, 1980). Also, the numberous projects which relied on readability formulae to determine the difficulty of reading materials (Diehl, 1980; Mockovac, 1974; Moe et al., 1979) are subject to question (Curran, 1976; Horne, 1979; Jacob & Crandall, 1979). The weakness of other studies has been the sole use of mailed questionaires (Farning & Boyce, 1976; Howell, 1976), the reliance on self-report data (Diehl & Mikulecky, 1980), and/or data gained from supervisors/employers (Smith, 1976). General job analyses done by task analysists in business, industry and the military are considered too general because they are based on representative tasks rather than actual specific tasks (Diehl, 1979; Horne, 1979). Academicians and educators point to the need for a better method of determining vocational reading demands. It has been recommended that the procedure should involve interviews with individuals in the actual environment where the reading is done, observation for verification, and the use of other than a formula to determine the difficulty of reading materials (Horne, 1979; Jacob & Crandall, 1979). Once it has been determined what the reading demands are for both the training and incumbency situations, it can be determined to what extent the trainee is being prepared for either.

SIGNIFICANCE OF THE STUDY

Based on the interrelationships between reading, education and employment, it may be argued that reading should be emphasized as both a learning medium and a vocational skill. To minimize or circumvent reading in the vocational education setting is to ignore the contribution of reading to learning. Although the relationship between reading and education is complex and controversial, it has been well established that reading is both a basic skill to be learned and a tool to facilitate learning. As a mode of learning, reading is unique: Goodman (1970) noted that print possesses "code and channel" characteristics that preserve and convey information differently than other learning modes. Special characteristics of print allow for personalized/individualized information retrieval and processing: the spatial qualities of the written code permit the reader to slow or stop the flow of the message for immediate processing, to pause for emphasis, to reread for further meaning, and to ruminate upon abstract interpretations with the stimulus still in hand (Palmer, 1978). The significance of such independent learning was emphasized by Dulin (1978): "Learners who combine a strong reading skill with a knowledge of how and where to secure the reading matter they desire need never reinvent the wheel or rediscover fire..." The ability to perform, independent of supervision or interpretation, is the ultimate teaching goal of any occupational program; if the student can be taught the keys to understanding job-related literature, the student is closer to independence in performance (Thornton, 1979). A primary purpose of education, then, is the transmission of knowledge and skills, a primary source of which, even in vocational education, is the written text. Reading therefore makes possible the communication between author/authority and reader/learner.

Just as there is an established relationship between reading and education, there exists one between reading and employment. The functional literacy movement has emphasized the ability to read job-related materials as a major occupational/functional skill. The Adult Functional Reading Study (Murphy, 1975), sponsored by the Educational Testing Service, determined that "reading materials at work is a critical part of the domain (of reading activities). A relatively large number of people perform such tasks for a relatively long time and consider them highly important." Sharon (1973), in a major study for the Educational Testing Service involving 5,067 adults, reported that 33% of the sample read at work (out of 38% of adults working on a typical day), that job-related reading was viewed as highly important, and that the people who read at work tended to be from a higher socio-economic level. Diehl (1979) noted that reading at work appears to be an ubiquitous activity; close to 99% of the subjects interviewed for one hundred different occupations representative of the total American employment scene reported doing some reading at work each day. Reading, in most cases, is essential to job entry, survival and upward mobility. Just as the ability to read promotes independent learning, so it promotes independent working; the ratio of supervisor to employee/worker is generally insufficient to allow constant interpretation of reading materials for the worker (Thornton, 1977). The importance of reading was summarized by Bricknell (1975): "The fundamental vocational skill in our society is the ability to read. A person has to be able to read to find out about available jobs, to get a job, to keep a job, to get ahead in a job and change to another job." To this list should be added the necessity to read in training for a job, which in turn points to the relationship between education and employment in which reading plays an integral part.

Reading skill is both a prerequisite to and component of the pre-employment training phase in which the skills and knowledge of the occupation are imparted to the prospective job incumbent. The vocational education program may be the ideal place to inculcate the importance of reading to learning and to working. Since any trade or occupation involves specialized reading materials, approaches to and uses of those materials should be taught in the training program; as well, occupational materials could be used to promote/strengthen basic reading skills. Significant trainee motivation to learn new reading skills and strengthen weak ones should exist, as the acquisition of immediately applicable, job-relevant skills is a major concern of adult students (Carp, 1973; Hameister & Hickey, 1977; Herem, 1978; Knowles, 1970; Tough, 1971). In addition, student motivation is increased by the use of relevant, occupational reading materials and by the functional approach of teaching skills as they are required by the materials (Vacca & Vacca, 1981). Horne (1979) notes that the more immediate reinforcement available from the relevant use of skills should not only increase retention of the skills, but also the retention of the at-risk students in the program. Furthermore, according to Conroy (1980), the vocational education instructor is the person most suitable to teach specific reading skills related to print materials used in the trade: the instructor has first hand practical knowledge of the manner in which occupational materials should be read, understanding of the concepts and technical terms, intimacy with the nuances of the trade, and skill with machinery, materials and procedures. Lee (1981) noted that one of the most important things an instructor can do is to project an attitude that demonstrates the value of knowing what a technical term means. The conclusions of this study, therefore, may have inescapable implications for the design of instruction and the role of the instructor in trades education.

Implications exist, as well, for education in general. Preparation for work is not a concern of conventional schools, but perhaps it should be. Mikulecky (1981) pointed out that job preparation should not dictate the curriculum but that is should be one goal of the educational system. Diehl (1980) suggested that schools may be preparing students mainly for higher level occupations by stressing read-to-learn and read-to-assess tasks; this may be unrealistic and undesirable from the point of view of business and industry. Bricknell (1975) argued that reading and study skills essential in certain vocations should be identified and taught from the beginning grades. Diehl and Mikulecky (1980) noted that if functional and schooling tasks are substantially different, and if functional tasks are strongly influenced by context, the argument that schools do prepare students to be functionally literate is questionable. In summation, implications may become apparent for the teaching of English and communication skills at all levels of education.

SUMMARY

This study was an examination of the curricular/training reading demands and occupational/on-the-job reading demands that together comprise the vocational reading demands of the plumbing trade. To date, the actual specific reading demands of the plumbing trade have not been determined, and the current methodologies for attempting the ascertainment thereof have been subject to much criticism. For this reason, the procedures of this study are possibly as significant as the findings. The initial purpose, then, was to determine the variety, complexity, frequency, importance and difficulty of the reading tasks encountered in each component of the vocation, and the concurrent reader strategies and competencies. This study further examined the preparation tradespeople received to handle the reading demands of either component while in the educational/training situation. A review of the literature pertaining to functional/occupational literacy, content area reading instruction, readability assessment, and occupational/industrial education revealed numerous reading-related issues and concerns. In general, there was evidence to suggest that reading is an important occupational skill, but it was not known to what extent this was the case in the plumbing trade. As well, studies have shown the reading demands while training for the job to be different from reading demands in the actual job incumbency; this has led to serious implications for the training program where prospective tradespeople are supposed to be instructed in the skills required for successful job completion. Reading-related problems can be and often are presented by the reading materials, the students, the instruction, and/or combinations thereof. Evidence suggests that reading, as both an educational tool and a

vocational skill, is not being addressed in many vocational education programs. Therefore, this study was an examination of the current treatment of reading within the apprenticeship program as it relates to the actual demands encountered by trainees and journeyman plumbers.

CHAPTER TWO

REVIEW OF THE LITERATURE

The purpose of this study was to examine the vocational reading demands of one occupation, in both the training component and job incumbency, and to determine the preparation individuals received to handle those demands. Such a study is related to four separate, yet interrelated academic fields: technical/vocational education, functional/occupational literacy, content area/functional reading instruction, and readability assessment. Studies in technical/vocational education indicate that reading, as a vocational skill, should be addressed within the job training component, but that numerous reading-related problems exist in occupational education. In brief, research in the area of functional literacy has determined reading to be an important vocational skill, and has provided methodologies for attempting to ascertain the reading demands of a given occupation. Investigations in content area reading provide a rationale and methodology for the functional instruction of reading. Finally, research in the field of readability assessment indicates the complexity of matching reading materials to the needs and abilities of the intended users. A review of the area of reading in technical/vocational education may be found in Chapter 1; following is the explanation, background and significance of the remaining three: functional/occupational literacy, content area reading, and readability assessment.

FUNCTIONAL/OCCUPATIONAL LITERACY

The study of occupational literacy has, as its origin, the concern for functional literacy. The attainment of functional literacy, the ability to read and write well enough to function in contemporary society (Diehl, 1979), is an extension of the concept of basic literacy, the abllity to read and write a simple message in some language as defined by the U.S. Bureau of the Census, 1963. In the 1960's, the American Right to Read effort raised society's literacy consciousness by emphasizing the critical role of literacy in rendering a person employable. The term "functional literacy", first used in World War II by the American Army to categorize individuals who could not use written instructions to adequately perform basic military tasks (Cook, 1977), evolved to distinguish competencies needed to perform reading tasks related to real- world experiences (Carroll & Chall, 1975; NAEP, 1975). Many attempts were made to determine the extent of functional illiteracy in the U.S. and Canada, studies which used different definitions of the concept, which employed different measures, and which arrived at estimates of illiteracy ranging from 1 to 20 per cent (Census Bureau, 1960; Fisher, 1978, National Health Survey, 1973). 'Grade completed' was the criteria for determining literacy used by the U.S. Census Bureau, UNESCO and the American Army; 'grade level equivalency scores' were used by the National Health Survey, the Clearinghouse for Offender Literacy (1975), Sticht et al. (1971) and others. Due to the inadequacies of these measures (Kirsch & Guthrie, 1980), several assessments, based on the concept of reading for survival in society, were developed employing representative samples of real life reading and/or writing tasks: NAEP's Mini-Assessment of Functional Literacy (1975), the Survival Literacy

Study (Louis, Harris & Associates, 1970), Reading/Everyday Activities in Life (Lichtman, 1974), the Adult Functional Reading Study (Murphy, 1975) and others. Much research has been directed toward defining and measuring functional literacy, and toward developing methods and materials for the promotion of higher levels of functional literacy. Further to that, Sticht et al. (1972), Olson (1975), Fisher (1978) and Kirsch and Guthrie (1980) emphasized the need for research to determine how literate a person must be to function in some defined adult situation by picking out reading tasks encountered in a specific situation, analyzing them and ascertaining the competencies of people who actually complete these tasks. The specific area of job-related reading was pointed to by Bricknell (1975), Levin (1975), Miller (1973) and others. Diehl (1980) noted that occupational literacy is one particular domain of life activities in which to examine the interplay of literacy demands and competencies; that occupational literacy skills have been found to be a highly important functional skill; and that the study of occupational literacy has implications for schools, Adult Basic Education programs, business and industry, and the setting of literacy requirement for jobs. Thus, the study of functional literacy has been narrowed, by some, to the study of functional job literacy or occupational/vocational literacy.

The efforts to gather information relevant to defining occupational literacy have been categorized as either general job analyses or designed specifically to provide information on functional job literacy (Horne, 1979). As Horne noted, numerous general task analyses have been done. Large companies such as the Bell System and the Digital Equipment Corporation produce detailed task list for some jobs. In the military, various projects of a similar nature, such as NEPDIS (1977), have been undertaken to support training program development. In the educational research field, summary task lists have resulted from vocational/technical curriculum development projects: development and verification of a list of the competencies for the communication skills area in vocational- technical post-secondary education was undertaken by Farning and Boyce (1976) and by Howell (1976); Smith (1976) investigated the generic communication skills in a number of occupations. In addition to research studies, such occupational handbooks as the _Occupational Outlook Handbook_ (U.S. Department of Labor, 1978-1979), the _Analysis of Occupations Series_ (Ohio State University, 1973), and _Careers Today_ (Hawes et al., 1977) give indications of the requirements for education and levels of reading and writing skills for specific jobs. However, these levels, often in the form of summary task statements, seem to be arbitrary, with most of the requirements stated in general terms: high school education, GED, college courses; such summary task statements provide little information about actual literacy requirements of jobs (Mikulecky & Diehl, 1979). Horne (1979) added that general job analyses done by task analysts in business, industry and/or the military involve questionable methodologies and are too general to be really useful in determining specific functional literacy skills. Another problem with general task analyses is that they are generally based on representative tasks rather than actual tasks (Diehl, 1980; Horne, 1979). Jacob and Crandall (1979) noted that a structural description or typical job description is not sufficient to define the functional literacy requirements of a job, since these usually focus on routine and recurrent aspects of the job, and tend to omit the miscellaneous tasks which so often involve reading. Therefore, the limitations of general task statements point to the need for the second category, procedures designed specifically to provide information on functional job literacy.

In a relative sense, not much research has been conducted in the area of specific literacy demands for individual occupations. Most current endeavor is based on the monumental work of Sticht and his various colleagues at the Human Resources Research Organization. Within the military environment, the research of Sticht et al. focused on determining the literacy demands of jobs, determining the relationship between literacy-ability and job-ability, developing reliable and valid testing procedures for matching individuals with jobs, and developing ways of restructuring materials to reduce the literacy demands. Among the numerous contributions to current research were the FORCAST readability formula (Caylor et al., 1973) designed to be used with job-related reading materials, and the categories for literacy strategies (reading-to-do and reading-to-learn) which Diehl (1980) expanded upon. Three important conclusions drawn by Sticht (1975) were: 1. a substantial portion of job trainees are deficient in job reading skills; 2. six weeks of focused job reading training improved job reading skills at least two reading grade level years specific to job reading skills; and 3. programs of intergrated job reading and job skills training are feasible. Much occupational-literacy research has been conducted by the military; however, it is difficult to obtain, and may not be generalizable to the civilian environment (Mikulecky & Diehl, 1979). Research in the civilian sector has tended to be minimal; it appears that most research being conducted on testing and establishing literacy requirements is done within companies and is not published. Some data on the literacy requirements of clerical occupations is available: Heinemann (1979) analyzed the performance of secretaries in job-related reading tasks; Ross (1980) conducted an analysis of the nature and difficulty of reading tasks associated with beginning office workers' jobs. Spicer (1975) attempted to identify the communication competencies required by future businesspersons; Moe, Rush and Storlie (1979) described the literacy requirements necessary to hold a job in ten occupations and the corresponding requirements necessary to succeed in vocational training programs which prepare individuals for each of those occupations; Diehl and Mikulecky (1980) interviewed workers in one hundred occupations and examined the general nature of on-the-job literacy tasks, the difficulty of job materials, the relationship between that difficulty and an individual's reading ability, the relationship between literacy and job success, and the characteristics of competent and non-competent readers. Direction was given to present and future research by the criticisms and comments of such as Jacob and Crandall ("Job-Related Literacy: A Look at Current and Needed Research", 1979), Horne ("Functional Job Literacy: Implications for Instruction", 1979), Mikulecky and Diehl ("Literacy Requirements in Business and Industry", 1979) and Thornton ("Review and Synthesis of Reading in Post-Secondary Occupational Education", 1980). Jacob and Crandall stated that it is important to observe and interview more than one representative of a job, and to use appropriate instruments to examine the difficulty of reading materials in order to create a valid profile of the reading demands of that occupation and the strategies which individuals in those jobs use to fulfill said demands. It has been recommended that the procedure should involve interviews with individuals in the actual environment where the reading is done, observation for verification, and the use of other than a formula to determine the difficulty of reading materials (Horne, 1979; Jacob & Crandall, 1979).

The concerns of researchers, then, have filtered down from basic literacy through functional literacy to occupational literacy. The field of occupational literacy can further be divided into literacy demands on the job and literacy demands training for the job. With regard to the latter, various programs have been developed: Lamantino (1976) designed a workbook containing instructional materials on twenty different vocational areas; Louisiana's Lafayette Parish Vocational Center designed an adult education curriculum guide based on instructional materials related to employees' occupational needs; Moe et al. (1979), Ross (1980), Heinemann (1979), and others made recommendations for job preparation programs. According to Thornton (1980), however, there is insufficient research into occupational reading to forge ahead with reading instruction in vocational education. Identification of numerous reading-related problems within vocational education and implications for instruction have resulted from Thornton's studies of reading in technical/vocational education: "Carpentry Literature. Readability VS Reading Ability", 1977; and "Review and Synthesis of Reading in Post-Secondary Occupational Education", 1980. Further research into curricular and occupational reading has been conducted by Mikulecky: "Job Literacy: The Relationship Between School Preparation and Workplace

Actuality", 1981. The significant conclusions drawn by Mikulecky, Thornton and others with regard to reading in technical/vocational education are that curricular reading demands involved with training for a job are often different from occupational reading demands on the job; that curricular reading and occupational reading are seldom addressed in technical/vocational education although reading-related problems do exist; and that not enough is known about the actual reading demands of any given occupation to address the reading-related issues and concerns. In summation, the study of the curricular and occupational reading demands of a specific trade or occupation is a logical step beyond the generalized studies of functional/occupational literacy to date.

FUNCTIONAL/CONTENT AREA READING

This study is concerned with vocational reading as it relates to two situations: the pre-employment training situation and the actual working situation. Although the two have traditionally been considered separately, they may be viewed as parts of a whole. Despite their sequential rather than simultaneous use, the entire range of skills required to successfully complete formal training are as much job-related as manual skills developed in an employment environment. Therefore, if the training process for a given occupation involves writing a certification examination, then reading and study skills are vocational skills. From this perspective, the reading tasks completed in the training/educational environment require instructional consideration as much as do manual skills or computational skills.

Support for the evaluation and instruction of functional reading skills may be derived from the "content area reading movement". The philosophy that reading can and should be a concern in all subject area instruction holds true as much for vocational programs as for academic programs. The primary goal of instruction is the student's mastery of subject area content, and if reading materials are a source of knowledge and instruction, a student's success depends on the ability to use them. Many instructors simply assume that students have the necessary reading skills and that curricular materials present no problems (Herber, 1970); others, however, are aware that such an assumption maybe naive. (Duke & Powers, 1973). Problems which occur in the educational setting, then, may be presented by the reader, the reading materials, the instruction and/or the context.

The curricular reading materials, which may include blackboard notes, teacher-made handouts, examination questions, trades manuals, instruction sheets, safety regulations, and textbooks, present problems when there is a mismatch between the literacy skills of the student and the literacy demands of the print/text. Assuming that the student has a reading ability level commensurate with course prerequisites, research indicates that some textbooks used are too difficult for many students to comprehend: Schulteis and Napoli (1975) reported that 60% of current bookkeeping texts are written at levels too difficult for their intended users; Thornton (1977) indicated that a large number of samples of carpentry literature used in secondary vocational programs require a college level reading ability; Clark (1978) found that twenty-five junior and senior high industrial education textbooks had readability levels ranging from 9.3 to 13.3 with a mean of 11; Creamer (1968), Gibson (1971), McClellan (1971), and Griffin (1981) indicated that students in high school equivalency programs in community colleges tend to have a reading level lower than the readability level of their texts. The reading difficulty level of teacher-made reading materials seemingly varies with the instructor's purpose and degree of concern with student comprehension. The difficulty level of trades manuals and other occupation-specific materials in generally high because the major requirement is that the information be detailed and accurate, not necessarily generally comprehensible (Lee, 1981; Thornton, 1979). The actual process of readability assessment, as a separate, controversial topic, is dealt with in depth later in this chapter. Suffice it to say that, in the educational context, curricular reading materials may present difficulties for students.

Within content area classrooms, individual students may experience problems of various types. Probably the problems of the student who is reading considerably below the expected/prerequisite reading level are beyond the capabilities of the content area teacher and require remedial reading instruction. However, the subject area teacher should be aware of and make attempts to help the generally proficient reader experiencing difficulty in a specific subject area or with a specific textbook. One type of problem arises when the text demands the reader to make use of knowledge which he/she does not possess (Stansell & DeFord, 1981). Since the meaning a reader derives from the written message depends on the knowledge and experience that is brought to the reading process, (Goodman, 1973; Pearson & Johnson, 1978), comprehension may not be possible without additional concept development. Smith et al. (1978) concluded that the nature of the text and the student's existing understanding of the topic may combine to "inexorably and physiologically" prevent the student from reading. Another type of problem results when the reader's language proficiency is insufficient to assess the knowledge within the text. If the reader is unable to efficiently use graphophonemic, syntactic and/or semantic systems employed by the text, the processing of information will be impaired (Stansell & DeFord, 1981). Interference in comprehension results when the reader is not actively involved in selecting, assimilating, constructing and reconstructing meaning from what is already known. A third type of problem results when the student has deficits in textbook-specific study skills. Often it is assumed that the student who can read well can use the textbook effectively as a learning aid; however, this is not necessarily the case. Hawkins (1977) has indicated that scores on reading tests do not correlate highly with scores on study skills tests. Fourthly, a student may be prevented from benefitting from textbook reading by deficiencies in subject-specific reading skills. Inherent in each subject area is a predominance of certain skill requirements (Cheek & Cheek, 1981); and a student may only be weak in a particular area. Ultimately, reading problems caused by either the reader, the textbook, or both negatively effect achievement in content area classrooms.

The awareness of the relationship between skill in reading and success in content subjects has given rise to the concept of "content area reading instruction." Basically, this concept involves the means and methods of improving reading, language and thinking in every classroom (Manzo, 1980). The basis for the concept of content area reading instruction appears to be twofold: there is the belief that 1) the developmental skills of reading, language and thinking need to be nurtured continuously and rather explicitly throughout the school years, even in college, and 2) the content area teacher is in the best position, in terms of daily contact with students, to promote these skills concurrently with the skills and objectives of each content class. With regard to the first point, Johnson (1980) noted that significant growth in the reading process occurs throughout the adolescent years, that continuous attention to this potential growth is an important aspect of the secondary school curriculum, and that providing for continuous student progress in the ability to read requires coordination in reading instruction from level to level, K-12+. With regard to the second point, it was stated that, as reading permeates the curriculum and as text materials in different subject areas place different demands on readers, subject matter teachers should teach those skills which students need to successfully read content materials. To this, others add that the content area teacher general, and the vocational teacher in particular, is in an ideal position to provide the student with the opportunity to learn or review a specific reading skill, to personally experience the relationship between reading and subject-specific tasks, and to use reading in a particular situation. (Conroy, 1980; Lee, 1981; Thelen, 1979; Thornton, 1979). Not only, then, is there a need for content area reading instruction, there are opportunities for it. The public outcry which has resulted in such movements as Back to the Basics, Right to Read, Accountability, Competency Testing and Functional Literacy, has put pressure on administrators, curriculum developers and teachers in virtually every subject area and at every grade level to incorporate reading instruction into content area programs.

The importance of content area reading has been recognized by many; however, some of the solutions and alternatives which have been recommended and attempted present additional problems. Quimby (1976), Gage (1974) and others advocated teaching word attack skills to the frustrated reader, a remedial task seen by some as too basic and time-consuming. Gage (1974), Schulteis and Napoli (1975) and others suggested that the teacher rewrite troublesome content material at a lower level of difficulty, an arduous task. Others, like Feely (1975), advised multi-level textbooks so the teacher can assign students materials on their proper reading level. However, multilevel texts are scarce and expensive; and research by Daugs (1973) suggested that statistically significant differences in achievement are not found between classrooms using multilevel texts or using one level of material. Aukerman (1979) advised the multitext approach, offering students a variety of materials including newsmagazines, reference books, trade books, anthologies, high interest/low vocabulary books. This approach requires an extensive library and/or budget; as well, the multitext approach does not guarantee a multilevel approach (McClain, 1981). A drastic alternative chosen by others is to simply not expect students to read. Rieck (1977) found that tests given in content classrooms often covered only material from lectures and class discussions rather than text reading; in addition, students were rarely required to discuss their readings. This forces students to be dependent on lectures and discussions for information, thereby disallowing the opportunity to become independent learners of the subject (Kealey, 1980; Palmer, 1978; Readance & Moore, 1979). It has been suggested that the above efforts at circumventing reading problems probably involve much more time and effort than does the incorporation of content reading instruction into the subject area program.

At this point it becomes necessary to define more specifically what content area reading instruction is. Readance, Baldwin and Dishner (1980) suggested that content reading be thought of as "content communication," which focuses on teaching practices designed to teach more effectively the essential concepts of subject matter areas and to enhance student learning from text. They noted the distinction between learning to read and reading to learn; whereas a developmental or remedial reading specialist may have responsibility for both, the subject matter specialist should have responsibility for only the latter. Cheek and Cheek (1981) pointed out that, in the content areas, reading skills are synonymous with "learning skills" which help the student in grasping content material. Whereas the content area teacher should not have to directly teach reading skills, he/she should incorporate learning skills development into the regular program. Most specifically, content area reading instruction may take the form of skill-centered instruction or content-centered instruction. The skill-centered approach is synonymous with the direct teaching of reading at either the elementary or secondary level; the content-centered approach is related to the functional teaching of reading. Underlying the direct teaching of skills is the assumption that the skills take precedence over the concepts. In contrast to this, the indirect teaching of reading rests on the assumption that reading should be taught functionally, ie. when the students need such instruction (Herber, 1978; Vacca, 1977). Whereas it is probable that content area reading instruction could be optimized by the utilization of both approaches, most authorities approach the teaching of content area reading from the content-centered or functional point of view.

In keeping with the procedure for the functional teaching of reading or concept-centred approach, Cheek and Cheek (1981) outlined a five-step process for incorporating reading skills into the content areas. The first step is to identify the reading skills which are important for the specific subject area; this may be done with the help of tables such as that provided by Cheek and Cheek. The second step is to determine the subject-related concepts to be taught during a specified period of time. The third step is to determine the reading skills which are necessary for the students to use in learning each concept; this is usually only one or two skills per concept. The fourth step is to ascertain which students understand the skills necessary for learning the content materials. The learner's instructional reading level, vocabulary proficiency and comprehension abilities may be diagnosed in numerous ways: Cushenberry (1978) suggested the oral reading test, a sight word test, the cloze procedure, a group informal reading inventory or a functional reading test; Cheek and Cheek (1979) added observation, a simplified reading inventory, an informal reading inventory (IRI), a group reading inventory (GRI), or a criterion-referenced test. Carvell (1980) noted that a textbook-specific study skills inventory can be used to determine whether or not students can use a given text efficiently. To diagnosis of the student's abilities, Hansell (1980) added a measure of the text's readability and resulting suitability. The fifth step in the content reading instruction procedure is to outline teaching strategies for the development of the concepts and skills. Vast numbers of strategies are available.

Books and articles on content reading instruction are in abundance, and provide different alternatives and approaches. An example is the teacher-constructed study guide, consisting of questions on background, vocabulary, organization, cause-and-effect, and detail, which can provide a student with a structured approach to the material (McClain, 1981). The value of the study guide is that it sets a purpose for reading, allows students to relate to the material, helps them evaluate the information, and increases reading time which may enhance comprehension (Tutolo, 1977). Similar to the study guide is the teacher-constructed reading guide which should 1) take readers through the vocabulary essential to the understanding of the lesson; 2) relate the reading material to concepts already known; 3) ask students specific questions related to diagrams, photographs, and illustrations; 4) direct readers to specific answers to questions; 5) tell readers what not to read (Smith, Smith & Mikulecky, 1978). Variations on the reading guide are the Directed Learning Activity (Cheek & Cheek, 1981), the Directed Reading Activity (Griffin, 1981), Directed Discovery Learning (Lewis, 1979) and others. Textbook-specific study skills can be developed through instruction in such techniques as SQ3R, OK4R, and others. Vocabulary development may be enhanced by the use of graphic organizers (Barron, 1969), structured overviews (Vacca, 1981), procedures such a SAVOR (Subject Area Vocabulary Reinforcement, Stieglitz & Stieglitz, 1979), and others (Griffin, 1981; Kossack et al., 1980). "Slicing comprehension tasks" (Pearson & Johnson, 1978) is suggested as an effective way to differentiate the guidance students receive as they deal with content area reading assignments. Manzo (1980), who theorized that skills, abilities and attitudes are best imparted through "oral languaging" (Manzo & Sherak, 1978), outlined three instructional methods: the Oral Reading Strategy, the C/T/Q Strategy (Concepts/Terminology/Questions), and the Questions-Only Strategy. That such techniques are effective when used in content area classrooms is supported by various research studies (Barron & Stone, 1974; Herber, 1964; Vacca, 1977). As well, numerous other studies have been reported that indicate trends favoring a content area reading focus (Herber & Sanders, 1969; Herber & Barron, 1977; Herber & Vacca, 1977; Herber & Riley, 1979).

In conclusion, academic endeavor in the area of content area reading has revealed a rationale for and methodologies to facilitate the functional instruction of reading in subject area classrooms. The lack of functional reading instruction has been determined to be a major problem in technical/vocational education. A purpose of this study, then, is to determine the role and treatment of reading, or the extent of functional reading instruction, in the trades apprenticeship program.

READABILITY ASSESSMENT

Readability, as a measure of the reading difficulty of written material, is a complex and controversial issue. The major reason for readability assessment is the possible existence of a mismatch between the reading level demanded by a particular text (printed matter, narrative or expository prose) and that of its intended reader. In the educational setting, the readability of material should be less than or equal to the reading skill of the learner to facilitate maximum learning (Abram, 1981). In the occupational and functional settings, feasibility and efficiency of task completion are similarly affected. If there appears to be a communication problem between reader and text, readability assessment may provide an indication of the extent of the mismatch. Should there be a degree of mismatch, instructional decisions and remedial efforts may be based on the difficulty areas pointed to by the assessment. Perhaps, however, the existing materials are written at a level too high for the intended audience, in which case it may be feasible to select different, more appropriate materials for individuals or groups. Alternately, it might be necessary to rewrite the existing materials, a process for which readability formulas may provide guidelines (Harrison, 1980). With few exceptions, reading cannot be avoided as an important aide to learning, to working and to general functioning in society. Many obstacles to the effective and efficient use of reading can be removed by matching readability of materials to reader's skill.

A definition of "readability" is difficult to arrive at, as there are numerous factors involved in the assessment of the difficulty of written materials. The interaction between reader and text is so complex that many facets are immeasurable and possibly unknowable. Such factors as the reader's own personal vocabulary, unique store of background information, individual interest, motivation, and general reading ability undoubtably affect the processing of reading materials (Diehl, 1980; Harrison, 1980; Stansell & DeFord, 1981; Vacca, 1981). Contributing, as well, are such dimensions of the text as legibility of print, illustration and color, vocabulary, charts and graphs, conceptual difficulty, syntax, organization, structural and stylistic elements (Harrison, 1980), use of redundancy, types of inferences, abstract terminology and others (Dawkins, 1975). With this in mind, Harrison referred to readability as the constellation of factors which together determine whether a reader will be likely to find a book attractive, interesting, and comprehensible. Curran (1976) hypothesized that readability is a necessary but not sufficient condition for comprehensibility, and that both are necessary but not sufficient for useability. Recognizing this complexity, researchers have attempted to develop procedures to take into account as many factors as possible. Irwin and Davis (1980) outlined a checklist approach to readability assessment which encompasses understandability and learnability. Anderson and Armbruster (1981) presented a similar process to evaluate the "considerateness" of a text. For Vacca (1981), readability assessment involved: 1. qualitative analysis, ie. the assessor's personal judgment of the reader's interests, experiences, abilities and motivation, and of the text's concept load, style and format; and 2. quantitative analysis, ie. predictive measures such as cloze and maze tests. Many quantitative procedures are available; the most common method of readability assessment has been the formula designed to calculate an average grade level for reading material.

Readability formulae are based on the premise of a relationship between ease of understanding of written materials and the style of writing used, a dimension entirely separate from content. Such countables as the number of words not on a list of common vocabulary, the number of syllables per unit length, or the number of words per sentence, are tabulated and converted, by multiple regression formulae, to grade level equivalencies. Numerous formulae exist, prominent among them the Dale-Chall (1948), Flesch (1948), FOG (Gunning, 1952), Spache (1953), SMOG (Mclaughlin, 1969), FORCAST (Caylor et al., 1973), Harris-Jacobson (Harris & Sipay, 1975), and Fry (1977). Formulas differ greatly in terms of age level accuracy, ease of application, and validity between the formula and another measure of text difficulty. In general, validation studies have shown that formulae tend to correlate between 0.60 and 0.70 with comprehension test scores (Harrison, 1980). As well, other validation studies have shown a high correlation between scores on formulae derived from comprehension test data and experts' pooled subjective assessments (Harrison, 1980). Formulae, therefore, may be significantly valid and reliable provided that the inherent limitations and restrictions are kept in mind.

Readability formulae are predictive: they do not measure text difficulty itself; they use generally established connections between certain text factors and actual difficulty as a means of predicting difficulty in other passages (Harrison, 1980). As was previously mentioned, there are numerous critical reader and text factors which they cannot take into account. As well, it is not possible to do readability estimates on very short passages, as formulae have been designed to be applied to whole passages of normal expository or narrative prose. Formulae do not apply to poetic writing, notes, printd forms, examination rubrics or graphical materials (Harrison, 1980; Jacol & Crandall, 1979). Diehl (1979) stated that, because much of the literacy material encountered on jobs is in the form of tables, charts and so on, readability formulae fall far short in providing any good assessment of the overall difficulty of job materials. Kern (1970) notd that: 1. readability formulae cannot match materials to readers at targeted reading grade levels; 2. rewriting to lower the formula readig grade level score does not increase comprehension; and 3. requiring tht text be written to satisfy a targeted reading grade level score focuses attention on meeting the score requirement rather than on organizing th material to meet the reader's information needs. The numerous limitations of readability formulae have prompted criticism of formulae in general (Curran, 1976; Diehl, 1979; Horne, 1979; Irwin & Davis, 198 Klare, 1974; Maxwell, 1978); and specifically of those studies which rty on a formula to determine the reading difficulty of written materials (Horne, 1979; Jacob & Crandall, 1979).

Various studies in the area of vocational and adult education hav employed different formulae, presumably for different reasons. The International Reading Association's Basic Education and Reading Commitee (1977), in a checklist for evaluating adult basic education reading materials, recommended Gunning's FOG Index. Thornton (1977), in assessing the readability of carpentry reading materials, considered twenty-four different formulae and selected the Flesch Reading Ease Formula, with the Fry Graph for Estimating Readability as a procedural check on validity. Moe et al. (1979), in determining the literacy requirements for ten different occupations, used the Fry Readability Graph in addition to the Dale-Chall Formula. Diehl and Mikulecky (1980), Mockovac (1974) and Sticht (1978) used the FORCAST formula which was developed by Caylor et al. for use with job-related materials. Despite the criticism of formulae, they are still used as a quick and quantifiable estimate of the readability of text.

With the acknowledged limitations, the FORCAST formula was used in this study to provide an indication of the difficulty of reading materials. Caylor et al. (1973), in a thorough review of the research on readability formulae, identified fifteen independent structural properties of text that are used in one or more readability formulae. Then they applied the different structural properties underlying readability formulae to analyzing job materials in military settings. By matching reading levels of men on the U.S. Air Force Reading test and cloze scores on passages with grade equivalency levels for the passages based on readability formulae, Caylor et al. were able to examine the relative usefulness of the structural properties in determining the reading difficulty of job materials. Based on their analyses, they concluded that the number of one-syllable words per 150-word passage was as reliable an indication of reading difficulty of materials as any of the other structural properties. In fact, Caylor et al. reported high intercorrelations between the FORCAST and other formulae and with reading grade levels based on the USAF reading test. As the FORCAST formula is based on the number of monosyllabic works in 150-word passage, it is minimally influenced by the specialized terminology found in occupational reading materials, which would probably be familiar to job incumbents; other readability measures, by counting numbers of letters, number of difficult words, or numbers of polysyllabic words, would tend to measure the technical vocabulary as more difficult than it is to an experienced worker (Diehl, 1980). Thus, Diehl felt that Caylor's formula may be more appropriate for job materials than other readability formulae. However, because of the limitations of formulae, other measures, besides the formula, were used to estimate the difficulty of materials in this study.

Although it is valuable to estimate the reading grade level of materials as an assessment of difficulty, more significant may be the (mis)match between the ability of the intended reader and the ability level demanded by the material. An informal procedure for estimating the readability level of materials, as well as determining an individual's reading level and diagnosing some possible reading difficulties, is the cloze procedure (Bormuth, 1966; Taylor, 1953). A cloze test is developed by using materials relevant but unfamiliar to the subject; in the cloze procedure, every fifth (or nth) word is deleted and the subject supplies the missing word. Reading ability of the subject and difficulty level of the material is determined or estimated by the number of missing words that are correctly replaced. According to Vacca (1981), the percentage of correct answers determines the level at which the reader interacts with the material: 0% to 40% correct is the Frustrational level at which

which the material is too difficult; 40% to 60% correct is the Instructional level at which instruction/assistance is needed for successful reading; and 60% to 100% correct is the Independent level at which the material presents no problems and can be used for independent instruction. However, the cloze procedure, and all other readability assessment procedures in fact, have many of the same limitations; therefore, a new procedure was attempted in this study. The criteria used to judge the reader/material match was that involved with the cloze procedure.

In summation, the communication between readers and materials is impaired when there is a mismatch between the ability of the reader and the ability level demanded by the material. Since this problem has been evidenced in occupational education in general, in this study, it was explored specifically in the plumbing apprenticeship program. To do so, both an approximate grade level and an assessment of reader/material match were undertaken based an current readability assessment procedures.

SUMMARY

As a foundation to this study, a review of the literature pertaining to functional/occupational literacy, content area reading instruction, readability assessment, and vocational education revealed numerous reading-related issues and concerns. In general, there was evidence to suggest that reading is an important occupational skill (Diehl, 1980; Murphy, 1975; Sharon, 1973; Sticht et al., 1971-1978), but it was not known to what extent this was the case for any given vocation, and for the plumbing trade specifically. As well, studies had shown the reading demands while training for a job to be different from reading demands in the actual job incumbency (Diehl & Mikulecky, 1980; Mikulecky, 1981; Moe et al., 1979; Ross, 1980; Sticht, 1978); this has led to serious implications for the training program where prospective tradepeople are supposed to be instructed in the skills required for successful job completion (Lee, 1981; Thornton, 1979). Further to that, studies in the field of content area reading instruction revealed that reading-related problems can be and often are presented by the reading materials, the students, the instruction and/or combinations thereof (Cheek & Cheek, 1981; Conroy, 1980; Herber et al., 1961-1979; Manzo, 1980; Readance, Baldwin & Dishner, 1980; Riley, 1979; Smith, 1976; Stansell & DeFord, 1981; Thelen, 1979; Thornton, 1977; Vacca, 1981). Finally, studies in readability assessment pointed to the difficulty in assessing the reading level of materials and attempting to match materials to intended users (Abram, 1981; Anderson & Armbruster, 1981; Curran, 1976; Diehl, 1980; Harrison, 1980; Horne, 1979; Irwin & Davis, 1980; Jacob & Crandall, 1979; Klare, 1974; Maxwell, 1978; Vacca, 1981). This study was, therefore, an attempt to tie together four distinct yet interrelated academic fields. It was, in part, an attempt to identify the vocational reading demands of the plumbing trade; ie. the dimensions of the actual reading tasks encountered. As well, it was an examination of the current treatment of reading within the apprenticeship program as it related to the actual demands encountered in separate job components, to the potential reading-related problems, and to issues in content area reading instruction.

CHAPTER THREE

PROCEDURES

PURPOSES OF THE STUDY

This study was an investigation of the vocational reading demands of the plumbing trade. The primary purpose was to compare and contrast the curricular reading demands encountered by apprentices in the educational setting and the occupational reading demands encountered by incumbents in the actual job situation. The secondary purpose was to examine the role and treatment of reading within the educational/ apprenticeship situation.

RESEARCH QUESTIONS

To accomplish the primary purpose, the reading demands of each job component were first determined, then compared. The following research questions were investigated separately within the apprenticeship/ curricular job component and the incumbency/occupational job component.

1. What specific reading tasks (ie. number and variety) were encountered in each job component?
2. For each task, what was the complexity, frequency perceived importance, purpose and process involved (ie. the profile of the reading task)?
3. How difficult were the materials read in each job component; ie. at what approximate grade level were representative materials written, and was there a discrepancy between the ability of the subjects and the ability level demanded by the material?
4. What was the significance of reading to the job component, in terms of time spent reading, use of alternative strategies (ie. information sought from non-print sources in completing a task that could be completed with the use of printed material), and general attitude toward reading?

The above research questions were first investigated separately in each job component, and then compared to accomplish the primary goal.

The secondary purpose, an examination of the role and treatment of reading in the curricular component, was served by two further research questions.

5. Was there evidence of functional reading instruction with regard to curricular and/or occupational reading materials?
6. Did any reading-related problems readily present themselves?

SUBJECTS

Two categories of subjects were involved in this study: plumbing apprentices/students and journeyman/incumbent plumbers. For the first category, the sample was drawn from apprentices enrolled in the trades apprenticeship program at Medicine Hat College. This study involved members of the fourth year apprenticeship class who were in the final stage of training before becoming journeyman plumbers. For the second category, five journeyman plumbers were selected at random from plumbing establishments listed in the telephone directory.

The reading tasks of the plumbing trade were those actually encountered and completed by the apprentice and journeyman plumbers; those tasks were not necessarily the same as the ones prescribed or outlined by other people involved with the trade. Therefore, only actual apprentices and journeymen were involved; supervisors, employers and instructors were not included. Whereas Smith (1976) had concluded that skill data may be reliably obtained from either workers or their immediate supervisors, other researchers had concluded that supervisors under-report literacy activities and forms (Jacob & Crandall, 1979; Mikulecky, 1981) or list extensive reading materials which are available but rarely or never used by incumbents (Caylor et al. 1973). Therefore, although it may have been advantageous to collaborate with instructors, supervisors and employers (Smith, 1976), such was beyond the scope of the current study.

DATA COLLECTION

To answer the research questions, four types of data were collected. Separate data-gathering instruments and procedures were involved with each.

Data was gathered through interviews with and observation of individual subjects in the functional setting, ie. the school or workplace where the reading tasks were completed. The exigency of interviewing subjects in the actual usage situations had been emphasized by Mikulecky and Diehl (1979), Diehl (1980), Mikulecky (1981), Horne (1979), Jacob and Crandall (1979) and others. Diehl (1980) had noted that functional literacy may be influenced by such extra-linguistic variables as the context of the reader's interaction with print, the reader's attitude and motivation to read, the rewards (or lack thereof) of completing the literacy task, and the frequency of the task; therefore, it was recommended that occupational literacy, of which reading is a component, be examined in a real context with the extra-linguistic variables and influences operating. Horne (1979) had added that "interviews are needed with students at sites where they complete assignments, attend lectures, etc. It would be unwise, for example, to simply assume that it is necessary to read the course text in order to succeed.....Interviews should also take place throughout the time students are engaged in whichever subject matter courses are being (undertaken)" (p. 15-16). The inclusion of the second procedure, the observation of individual subjects in the functional setting, was based on the limitations of self-report data. Mikulecky and Diehl (1979) had noted that people are often unaware of the reading they actually do on the job and fail to report many reading activities because they are so much a part of the functional task. Jacob and Crandall (1979) had added that it is important to verify people's conceptions of reading, as well as their impressions of what they read, the amount of time they believe they read, and the purpose for which they read. The observation process was an attempt, therefore, to verify and amplify the self-report data; data gathered through observation was combined with that gathered through interviews.

Significance of Reading

The first type of data gathered pertained to the significance of reading in terms of the time spent reading, the use of alternative strategies, and the general attitude toward reading (research question #4). A brief questionaire, Attitude Questionaire (Appendix A:1), was adapted from the Diehl-Mikulecky Job Literacy Survey (Diehl, 1980), and used to gather data. Subjects were asked to respond, on a Likert-type scale, to questions about reading in general and vocational reading in particular. As well, subjects recorded the amount of time spent reading during a usual working day. Because of the simple nature of this questionaire, it was administered first during the initial interview to put subjects at ease and to introduce the researcher's "concern" with reading. The data gathered provided an indication of the significance of reading as a vocational skill in the plumbing trade. As well, it was used as a partial indicator of reading- related issues and concerns (research question #6). Finally, this self- report data was used, in part, as a guideline for the observation procedure that followed the initial interview.

Curricular and Occupational Reading Demands

The second type of data pertained to the determination and subsequent description of the reading tasks actually encountered in each job component (research questions #1 and #2). To simplify the process (rather than ask the subjects to list the tasks they encountered), a list of potential tasks was developed. The list was based on that used by Smith (1976) and Diehl (1980), with additions suggested by the research of Thornton (1977). Twenty-three tasks were listed under the broad categories of forms, charts and graphs, reference, business communications, regulations, and instructions; and the list was assembled in checklist form with space at the bottom for additions by subjects. This checklist became the basis of the second instrument, a checksheet of reading tasks and profile dimensions, Task Checksheet (Appendix B:1). The completion of the checksheet was the second part of the initial interview conducted with individual students and incumbents. Subjects were first asked to indicate with a checkmark those tasks they encountered. Thus, the _variety_ of reading demands was the list of tasks encountered by subjects collectively in each job component. Then, for those tasks checked, subjects were asked to rate the profile dimensions on the checksheet.

The profile dimensions listed (other than variety) were complexity, frequency, perceived importance, general strategy (purpose) and specific strategy (process). These dimensions were adapted from the Diehl-Mikulecky Job Literacy Survey (Diehl, 1980). Each dimension was rated according to several categories, listed on an attached rating sheet. *Complexity* of a reading task was rated according to the type of display: 1. entire book; 2. part of a book/text; 3. part of a book/chart, graph, etc.; 4. one-to-three page text; 5. one-to-three page chart, graph, etc.; and 6. other. *Frequency* was rated as: 1. less than once a month; 2. once a week to once a month; 3. two-to-four times per week; or 4. daily. *Perceived importance* was rated as: 1. not important; 2. important but not vital; or 3. vital to the completion of a task. *General strategies* (purposes) were rated as: 1. reading-to-learn; 2. reading-to-do with no learning; 3. reading-to-do with incidental learning; or 4. reading-to-access. *Specific strategies* (processes) were: (within reading-to-learn) a. reread/rehearse; b. problem solve/question; c. relate/associate; d. focus attention/concentrate; (within reading-to-do with no learning) e. fact-finding in text; f. fact-finding in charts, graphs, maps, tables, etc.; g. following directions using text; h. following directions using charts, etc.; (within reading-to-do with incidental learning) i. special learning strategy (a. to d. above); j. repetition of reading task over days or months; k. single-trial learning; l. other (specify); (within reading-to-assess) m. usefulness for a particular task; n. whether to read more carefully later; o. whether to pass material on to someone else; or p. other (specify). A full explanation of the general and specific strategies and their categories is found in Appendix B:3. During the initial interview, subjects were asked to read over the Rating Categories for Task Checksheet, (Appendix B:2) and write a category number in each dimension. As far as possible, this was accomplished through verbal interchange with the researcher; subjects had difficulty with some dimensions.

As the data gathered in the initial interview was considered to be self-report data, the next procedure was an "observation" of each subject for the purpose of verifying and amplifying the data gathered thus far. The information provided by the Attitude Questionaire and the Task Checksheet served as a basis or guideline for the observation process. First, half of a working day was spent with each incumbent; the researcher accompanied the subject, recorded every incidence of reading and discussed the purposes and processes of reading. The record of each observation period can be found in Appendix C:1. Then, a full class day was spent with the students, observing and recording the reading done. It was not deemed necessary to observe each student individually, as the entire class encountered the same activities and procedures. The record of this observation period can be found in Appendix C:2.

The data gathered through observation was of an informal nature, and was used to amplify the data gathered in the interview. Thus, responses to the Task Checksheet were modified somewhat after the observation of subjects. Modifications were necessitated by misunderstandings in four areas. The first problem was a misinterpretation by subjects of the term "text" on the Rating Categories for Task Checksheet: the subjects understood the term to mean "words" and thereby interpreted anything with words to be text; however, tables may contain "words", according to the Oxford English Dictionary. Thus, some subjects rated purchase orders, invoices, application forms, schedule, catalogues and/or telephone directories as "text", while the researcher considered them to be "charts, graphs, tables, etc." The second problem was a difficulty with the terms "general strategy" and "specific strategy". These were the terms originally used by Sticht et al. (1977) and Diehl (1980); had the simpler terms of "purposes" and "processes" been used, subjects would have had far less difficulty completing the Task Checksheet. The third problem was in the "frequency" dimension where there were categories only for a positive response (less than once a month; once a week to once a month; two-to-four times per week; and daily). Had the category "never" been added to the rating sheet (as it was later), it could have been used as a double check on the tasks reported encountered. It turned out that, for many tasks, the most common response was actually "never" although one or two subjects reported encountering them. This basically necessitated two lists of reading tasks for each job component: the variety/number of tasks encountered based on total subject response; and the shortened list based on the most commonly encountered subject response (ie. commonly encountered tasks). Finally, the fourth problem was the inclusion of the term "textbooks" on the reading task list. Almost exclusively, the "textbooks" used were occupational materials used in the curricular setting; government code books and regulations, commercially produced installation and equipment publication, and others were treated as "textbooks". The confusion caused by these four problem areas was cleared during the observation procedure, and the necessary modifications were made to the Task Checksheet responses.

Data provided by the modified responses to the Task Checklist was analyzed first to describe the individual reading tasks encountered, and then to profile the reading demands of each job component. The total subject response was tabulated for each category of profile dimensions. Then, based on the most common subject response, reading tasks were listed according to dimension categores for each job component. From these analyses, it was possible to draw generalizations about and comparisions between curricular and occupational reading demands.

Difficulty of Materials

The third type of data, pertaining to the difficulty of reading materials (research question #3), was of two sub-types. One sub-type involved determining the approximate grade level of representative materials. A variety of materials, were provided by a trades instructor, and were grouped into four categories: pre-vocational materials used as curricular and occupational reference; curricular materials based on occupational materials; occupational materials used as curricular materials; and occupational materials used as both curricular and occupational materials. For these representative materials, an estimation of the readability (approximate grade level) was determined according to the FORCAST formula (Caylor et al., 1973). As both the concept of "readability" and the use of formulae are subject to extensive criticism (see Chapter 2), the purpose was to indicate the general reading difficulty level for the sake of comparison to other studies, and studies, and for the sake of estimating a potential grade level prerequisite. As the grade level of reading materials may be less significant than the match between the reader's competence and the ski level demanded by the materials, a second sub-type of data was gathere

To ascertain whether or not a discrepancy existed between the ability of the subjects and the level demanded by the material, the following procedure was undertaken. Three reading selections were tak from the representative materials provided by the instructor; the actu articles are reproduced in Appendix D:1. The instructor and researche together determined the major and minor points (the "message") of each selection; these are listed in Appendix D:2. During a second intervie with each subject (only seven of the original ten were available), the subjects were asked to read each selection and then explain what they ad read, following exactly the procedure outlined in Appendix D:3. The unaided recollection, or explanation, of each article was recorded, transcribed (Appendix D:4) and analyzed (Appendix D:5–D:7).

First, the verbalizations were read and marked for: text-based major points related verbatim, acceptably paraphrased, or unacceptabl paraphrased; text-based minor points related verbatim, acceptably paraphrased, or unacceptably paraphrased; and additions - consistent ad inconsistent. This data was tabulated on the record sheet, Appendix D:5, and analyzed in two ways. First, the percentage of major and mi points acceptably recalled (versus those unacceptably recalled or abs t) were tabulated for each of the three reading selections as verbalized y students, incumbents, and subject categories combined. The extent to which subjects could comprehend/recall/articulate the message of each was used as an indication of the reading difficulty of the materials. The criteria used was that employed with the cloze procedure of readability/reading ability assessment (Bormuth, 1966, 1975). According to that procedure, the percentage of correct "answers" indicates the level at which the reader interacts with the material: 0% to 40% correct is the "frustrational" level at which the material is too difficult; 40% to 60% correct is the "instructional" level at which instruction/assistance is needed for successful reading; and 60% to 100% correct is the "independent" level at which the material appears to present no problems (Vacca, 1981). Thus, the percentage of acceptably recalled major and minor points indicated the level at which the material and reader matched - independent, instructional or frustrational.

Then the data was re-analyzed to indicate the percentage of the total verbalization for each reading selection which was positive, ie. contributory to an academic recollection. Each verbalization contained some "additions"; these additions, sometimes at great length, appeared to be "filler" as subjects sought to explain what they had read. Thus it was felt that the "inconsistent additions" plus major and minor points unacceptably paraphrased indicated a reader's difficulty with the material. The extent to which the verbalizations about a selection were positive was used as a second indicator of how comprehensible and/or usable the selections were for readers. In summation, both an approximate grade level and an estimate of subject and material match were determined for some representative vocational reading materials.

Reading in the Curricular Setting

The fourth and final type of data pertained to the role and treatment of reading within the curricular job component (research question #5). To gather data, a questionaire was designed to examine the nature and extent of functional instruction in reading curricular and/or occupational materials. The Functional Reading Qeustionaire is found in Appendix E. For purposes of this study, the term "functional reading instruction" meant the direct or indirect teaching of reading skills using content area materials, which in this case were both curricular and occupational materials. Therefore, questions on the instrument reflected a concern for diagnosis and instruction in general reading and study skills, vocabulary development, concept development, comprehension, and occupation-specific reading tasks. Other questions reflected a concern for potential reading-related problems in technical/vocational education, ie. difficulties presented by the skill level of the students, the reading materials used, and/or the instruction they received. The questions on the instrument were based on issues and practices in the fields of occupational literacy, content area reading instruction, and occupational education (see Chapter 2).

The questionaire was administered to the entire fourth-year plumbing apprenticeship class at Medicine Hat College (nine students at the time) after the day of observation. The two instructors in the program completed the questionaire, as well, for the sake of comparison. From the response to the questionaire it was possible to examine the attention to reading, as an educational tool and/or occupational skill, in the curricular job component. As well, the data was examined for evidence of reading-related problem (research question #6).

SUMMARY

This study was, first, an investigation of the vocational reading demands of the plumbing trade, and second, an examination of the role and treatment of reading in the training component of the trade. Subjects were drawn from students in the apprenticeship program and journeyman plumbers in the actual job incumbency. The collection of data for this study was a four-part process, using interrelated procedures and instruments.

The first step was to determine and describe the curricular and occupational reading demands. Interviews were conducted with individual subjects (five students and five incumbents), and a "Task Checksheet" was completed by the subjects through verbal interchange with the researcher. This checksheet provided data on the variety, complexity, frequency, perceived importance, purpose and processes of reading tasks encountered in each job component. Following the initial interview, subjects were observed for the purpose of verifying and amplifying the self-report data gathered in the interview. The combined information was used to describe the individual reading tasks encountered in each job component, and to provide a composite profile of the reading demands in each job component for the sake of comparison.

The second step was to determine the difficulty of reading materials involved in the trade. A variety of representative materials were subjected to the FORCAST readability formula, and an approximate grade level was determined for each. As well, three selections from the representative materials were assessed for a match to their intended readers. In a second interview, subjects read and verbally recalled the

messages of the three selections; and the verbalizations were analyzed for the difficulty that they appeared to present to the readers.

The third step was to examine the nature and extent of functional instruction in reading curricular and/or occupational materials. To this end, a questionaire was administered to students and instructors in a plumbing apprenticeship program. As well, relevant notations had been made during the observation of the students (step one).

The final step was to identify any readily-apparent reading-related problems. This was accomplished partially through the analysis of an Attitude Questionaire administered to subjects in the initial interview, partially from questions on the Functional Reading Questionaire, and partially from the observation of subjects.

Data gathered for the study were analyzed and tabulated to answer the six research questions.

CHAPTER FOUR

RESULTS AND DISCUSSION

This study was an investigation of the vocational reading demands of the plumbing trade; ie. both the curricular reading demands encountered by apprenticeship students in the educational component of the trade, and the occupational reading demands encountered by incumbent journeymen in the actual work setting. The primary purpose, to compare the curricular and occupational reading demands, was initially served by two research questions. Investigated separately within each job component, they were directed at ascertaining the profiles of the reading tasks encountered. The dimensions of the reading task and demand profiles were the variety, frequency, complexity, perceived importance, general and specific strategies of the reading tasks. Two further research questions examined the difficulty of materials encountered, the time spent reading, the use of alternative strategies, and the attitude of the readers in each job component. These four research questions facilitated the accomplishment of the primary purpose: the identification of similarities and differences in curricular and occupational reading demands. The secondary purpose of the study, an examination of the role and treatment of reading in the educational setting, was served by two final research questions which reflected a concern for functional reading instruction and reading within technical and vocational education. In an attempt to answer these six research questions, data was gathered through interviews with and observation of plumbing apprentices and incumbents.

Question 1: Variety of reading tasks

> What specific reading tasks (ie. number and variety) were encountered in each job component?

To determine the specific reading tasks encountered in the curricular and occupational job components, subjects were asked to check, on the Task Checksheet, Appendix B:1, those tasks they actually encountered. The list of reading tasks, an enlargement of those used by Thornton (1977) and Diehl (1979), contained twenty-three tasks grouped into the broad categories of forms, charts and tables, reference, business communications, regulations, and instructions. Subject response to the checksheet is shown in Table 1; the numbers beside a given task show how many subjects from each category reported encountering the task. For example, no students and five incumbents encountered work orders; four students and two incumbents reported encountering application forms. In total, students reported fifteen tasks and incumbents, twenty-two; the specific tasks reported are indicated in Table 1. Although the checklist had room for additions by subjects, none were made; however, after observation of subjects, a minor addition by the researcher might be "rating plates" and "packaging labels" which were encountered by incumbents.

From Table 1, the following observations were made. First, the variety of tasks was greater in occupational reading than in curricular reading; twenty-two tasks as opposed to fifteen. Second, many of the same reading tasks were encountered in the two job components. Fourteen reading tasks were reported encountered in both job components: application forms, schedules, blueprints, telephone directories, dictionaries, textbooks, memos, trade manuals, company/school

Table 1: Variety of tasks completed
(total positive subject response)

	students (N = 5)	incumbents (N = 5)	N = 10
work orders	0	5	5
purchase orders	0	3	3
invoices	0	3	3
claims	0	2	2
application forms	4	2	6
schedules	4	2	6
blueprints	5	5	10
maps	0	3	3
telephone directories	2	4	6
dictionary	4	1	5
catalogues	0	2	2
textbook	5	3	8
letters	0	1	1
memos	3	3	6
trade manuals	5	5	10
company regulations	1	2	3
contracts	0	2	2
trade magazines	3	2	5
examination questions	5	0	5
safety & medical warnings	4	2	6
material installation proced.	5	4	9
tool & equipment directions	5	5	10
work/study procedures	4	2	6
other(specify)	0	0	0
incidence of positive response	15	22	23

regulations, trade magazines, safety and medical warnings, material installation procedures, tool and equipment directions, and work/study procedures. One additional task, examination questions, was exclusive to curricular reading; and eight were exclusive to occupational reading: work orders, purchase orders, invoices, claims, maps, catalogues, letters and contracts. Third, five of the fourteen mutually encountered reading tasks appeared to be most important; eight-to-ten subjects reported encountering blueprints, trade manuals, tool and equipment directions, material installation procedures, and textbooks. Fourth, the variety of tasks most commonly encountered was actually less than the total variety; thirteen of the curricular tasks and only eleven of the occupational tasks were reported by three-to-five subjects. As well, the most commonly encountered tasks were different between job components. For students, the most commonly encountered reading tasks were blueprints, textbooks, trade manuals, examination questions, material installation procedures, and tool and equipment directions (all 5 out of 5; 40.0% of all the tasks reported encountered by students); application forms, schedules, dictionaries, safety and medical warnings, and work/study procedures (all 4 out of 5; 33.3% of all the tasks encountered by students); and memos and trade magazines (all 3 out of 5; 13.3% of all the tasks encountered by students). For incumbents, the most commonly encountered reading tasks were work orders, blueprints, trade manuals, and tool and equipment directions (all 5 out of 5; 18.2% of all the tasks encountered by incumbents); telephone directories and material installation procedures (both 4 out of 5; 9.1% of all the tasks encountered by incumbents); purchase orders, invoices, maps, textbooks, and memos (3 out of 5 ; 22.8% of all the tasks encountered by incumbents). Hence it may be seen that, for 86.7% of the reading tasks encountered by students, three to five subjects responded affirmatively while for only 50.1% of the reading tasks encountered by incumbents, three to five subjects responded affirmatively. From this it was observed that the number of most commonly encountered tasks was greater for students, and that more students than incumbents encountered reading tasks, even though the variety was less for students than for incumbents. From these observations, it was concluded that the variety of reading tasks encountered in each job component may be larger than is commonly believed by either tradespersons or laypersons.

Question 2: Reading task profiles

> For each task, what was the complexity, frequency, perceived importance, purpose and process involved (ie. the profile of the reading task)?

Using the "Rating Categories for Task Checksheet", subjects rated the profile dimensions of the reading tasks they encountered. The fourteen tasks encountered in both job components had both curricular and occupational profiles; one further task had only a curricular profile and eight had only occupational profiles. The two profiles for each of those mutually encountered tasks were never identical, and very often, completely different.

The complexity of a reading task was rated according to the type of display: entire book; part of a book/text; part of a book/chart; one-to-three page text; one-to-three page chart; and other. On the Task Checksheet, subjects rated the complexity of the reading tasks they encountered, and the responses were modified slightly due to a misinterpretation, by subjects, of the term "text" (see Chapter 3, p. 48). From the total subject response, tabulated in Table 2 the following observations were made. First, for fifteen of the twenty-three tasks listed, the complexity rating was not disputed; ie. subjects agreed within and/or between job components. For the remaining eight tasks, the complexity rating appeared to vary according to the situation in which

Table 2: Complexity of tasks completed
(total positive subject response)

	entire book		part of a book/ text		part of a book/ chart		1-3 page/ text		1-3 page/ chart		other	
	S	I	S	I	S	I	S	I	S	I	S	I
work orders								5				
purchase orders										3		
invoices										3		
claims								2				
application forms									4	2		
schedules									4	2		
blueprints	1				4	4				1		
maps										3		
telephone directories					2	4						
dictionary			4	1								
catalogues						1						
textbook	5			3		1						
letters								1				
memos							3	3				
trade manuals	5			4		1						
company regulations							1	2				
contracts				1				1				
trade magazines											3	2
examination questions											5	
safety & medical warnings			3	1			1	1				
material installation proced.	3		1	1		1			1	2		
tool & equipment directions	3		1			1	1	0		4		
work/study procedures							4	1				1
other(specify)												
	17	0	9	11	6	13	10	16	9	20	8	3
% of positive response S	28.8		15.3		10.2		16.9		15.3		13.6	
I	0		17.5		20.6		25.4		31.7		4.8	

*S=Student
I=Incumbent

they were encountered. Second, the range of complexity encountered was different for each job component: students experienced the entire range, whereas incumbents encountered all of the categories except "entire book". For students, the incidence of reading tasks in complexity categories was fairly evenly distributed between the six categories whereas, for incumbents, four of the six complexity categories contained

95.2% of the reading tasks. Third, the most commonly encountered format or complexity was different between job components: students reported most commonly encountering the "entire book", whereas incumbents reported "one-to-three page chart". Based on the most common subject response in Table 2, the reading tasks encountered in each job component were listed according to complexity categories, Appendix F:1. It was observed that, for ten of the fourteen mutually encountered tasks, the complexity was rated the same in both job components. However, for four of the five most commonly encountered tasks (textbooks, trade manuals, material installation procedures, tool and equipment directions), the most commonly chosen complexity category was entirely different between job components. Because the materials were the same and the reported complexities were different, it has been concluded that the subjects' encounters with some important reading tasks were significantly different between job components.

Frequency of task completion was rated as: less than once a month; once a week to once a month; two to four times per week; or daily. In addition to that, the null response in the frequency categories was considered to be "never", thereby creating a fifth frequency category. In this respect, the frequency dimension of the task profiles was different from the other dimensions; in all the other dimensions, only the positive response to a task was reported, even though it may have been only one or two subjects. Table 3 shows the frequency of all the tasks listed as rated by both students and incumbents; and based on the total subject response, the following observations were made. First, for all of the tasks listed, the frequency varied between job components.

Table 3: Frequency of tasks completed
(total subject response)

* S=Student I=Incumbent	less than once a month		once a week to once a month		2-4 times per week		daily		null response	
	S	I	S	I	S	I	S	I	S	I
work orders		1						4	5	
purchase orders				2				1	5	2
invoices				2				1	5	2
claims		2							5	3
application forms	4	2							1	3
schedules	3		1	2					1	3
blueprints		2	1	2	4			1		
maps		1		2					5	2
telephone directories			1	2	1	1		1	3	1
dictionary	1		1	1	1		1		1	4
catalogues		1		1					5	3
textbook		2	1			1	4			2
letters				1					5	4
memos	1	1		1	1		1	1	2	2
trade manuals				4		1	5			
company regulations	1	1		1					4	3
contracts		1		1					5	3
trade magazines		1	3	1					2	3
examination questions					3		2			5
safety & medical warnings	2		1	2	1				1	3
material installation proced.	1	1	3	2	1	1				1
tool & equipment directions	1	2	3	2	1	1				
work/study procedures		1	1	1	1	1	2		1	2
other(specify)										
total	14	19	16	30	14	6	15	9	56	51
% of total response S	12.2		13.9		12.2		13.0		48.7	
I	16.5		26.1		5.2		7.8		44.3	

As well, within job components, the frequency varied for nine of the curricular tasks and twenty-one of the occupational tasks. It appeared, then that very few reading tasks were encountered at an exact or regular frequency within or between job components. Second, in both job components, the entire range of frequency categories was experienced, and the most common category was "never", (although two to three of the reading tasks most commonly rated "never" by students and seven to fourteen of those for incumbents were actually encountered by a minority of subjects in that job component). This supports the previous observation that the variety of commonly encountered reading tasks was actually much less than that of the totally encountered reading tasks in each job component. Based on the most common subject response in Table 3, the reading tasks were listed according to frequency categories, Appendix F:2. It was observed that, although the frequency rating varied within job components for some tasks, eleven of the tasks listed were most commonly rated in the same frequency category for both job components. However, the numbers and variety of tasks in frequency categories varied between job components; and of the fourteen tasks encountered in both job components, the most common frequency rating was different for nine. Therefore, the number and variety of reading tasks commonly encountered in frequency categories was significantly different between job components.

The *importance* of a reading task, as perceived by subjects, was rated as: not important; important but not vital; or vital to the completion of a task. Table 4 indicates the perceived importance of tasks encountered as rated by subjects, and promptes the following observations. First, as a percentage of all the tasks encountered in each job component, similar numbers were rated in each importance category; and in both job components, the majority of tasks encountered were most commonly rated "vital to task completion". Put simply, subjects in either job component very seldom read plumbing-related materials that were considered to be "not important". Based on the most

Table 4: Perceived importance of tasks completed (total positive subject response)

* S=Student
I=Incumbent

	not important		important but not vital		vital to task completion			
	S	I	S	I	S	I		
work orders		1				4		
purchase orders				1		2		
invoices		1				2		
claims						2		
application forms			4	1		1		
schedules			2		2	2		
blueprints					5	5		
maps				1		2		
telephone directories		1	1	1	1	2		
dictionary			3	1	1			
catalogues				2				
textbook			1	2	4	1		
letters				1				
memos	1		1	2	1	1		
trade manuals			1	1	4	4		
company regulations	1			1		1		
contracts				1		1		
trade magazines	1	1	2	1				
examination questions			1		4			
safety & medical warnings			2		2	2		
material installation proced.			2		3	4		
tool & equipment directions			2		3	5		
work/study procedures					4	2		
other(specify)								
total	3	4	22	16	34	43		
% of positive responses S	5.1		37.3		57.6			
I	6.3		25.4		68.3			

common subject response in Table 4, reading tasks were listed according to "perceived importance" categories, Appendix F:3. Of the fourteen mutually encountered reading tasks, students and incumbents agreed on the perceived importance of ten; and four of the five most commonly encountered tasks were rated as "vital to the completion of a task". In terms of differences in perceived importance of reading tasks between job components, it is understandable that incumbents rated as "vital" some tasks not even encountered by students and vice versa.

For a given reading task, the general strategy (purpose) was rated as either reading-to-learn; reading-to-do with no learning; reading-to-do with incidental learning; or reading-to-assess. Subjects hesitated to rate the tasks they encountered (see Chapter 3, p. 48), but observation of and discussions with the subjects assisted the researcher in rating the tasks. Table 5 reveals the general strategy rating of the tasks encountered in each job component; for most of the tasks listed and encountered, there was a most common general strategy category within job components, but for some this differed significantly between job components. Subjects from both job components reported encountering the entire range of general strategies; however, the most commonly encountered general strategy was different for the job components: "reading-to-learn" for students, and "reading-to-do with incidental learning" for incumbents. As well, the number and variety of tasks in each general strategy category varied within and between job components. Based on the most common response in Table 5, reading tasks were listed according to general strategies categories, Appendix F:4. Notably, no tasks were reported most commonly encountered by incumbents in the

Table 5: General strategies of tasks completed
(total positive subject response)

	reading-to-learn		reading-to-do with no learning		reading-to-do with incidental learning		reading-to-assess			
	S	I	S	I	S	I	S	I		
work orders				1		4				
purchase orders				3						
invoices				3						
claims				2						
application forms			4	2						
schedules					4	2				
blueprints	5					5				
maps				3						
telephone directories			2	4						
dictionary					4	1				
catalogues						2				
textbook	5					3				
letters								1		
memos							3	3		
trade manuals	5	1				4				
company regulations						1	1	1		
contracts						1		1		
trade magazines							3	2		
examination questions					5					
safety & medical warnings	4					2				
material installation proced.	5					4				
tool & equipment directions	5					5				
work/study procedures					4	2				
other(specify)										
Total	29	1	6	18	17	36	7	8		
% of total positive response S	49.2		10.2		28.8		11.9			
I	1.6		28.6		57.1		12.7			

* S=Student
I=Incumbent

"reading-to-learn" category. Of the fourteen mutually encountered tasks, eight were in the same general strategy category; but of the five most commonly encountered tasks, none were. From this, it was concluded that many of the same important reading materials were read for different purposes in each job component, and that the main purpose for reading differed between job components.

With regard to specific strategies, a reading task was rated according to thirteen explicit categories ("l" and "p", "other", were never chosen; "special learning strategy" -"i"- involved "a" to "d") (see Appendix B:3). Tables 6 and 7 reveal how subjects rated the reading tasks they encountered. As with general strategies, there was a most common specific strategy involved with almost all of the reading tasks within job components, and they were different between job components. The range and variety are very similar: six specific strategies were mutually used in both job categories, plus a seventh (reread/rehearse) when considering the combined use of it and "focus attention" by students. However, the incidence of specific strategy usage was substantially different between job components, as was the most commonly encountered specific strategy category. Based on the most common response in Tables 6 and 7, reading tasks were listed according to specific strategy categories, Appendix F:5. Students reported employing combined "reread/rehearse and focus attention/concentrate" almost half of the time, with the next most common being "problem solve/question". Incumbents barely reported employing those, and most commonly encountered "repetition of reading task over days or months caused learning to occur:, with fact-finding in charts, graphs, maps, tables, etc." a close

Table 6: Specific strategies of tasks completed - Students

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
work orders																
purchase orders																
invoices																
claims																
application forms						3	1									
schedules										4						
blueprints		5														
maps																
telephone directories						2										
dictionary											4					
catalogues																
textbook	5(a&d)															
letters																
memos													2	1		
trade manuals	5(a&d)															
company regulations													1			
contracts																
trade magazines														3		
examination questions		5							(5)							
safety & medical warnings	4(a&d)															
material installation proced.	5(a&d)															
tool & equipment directions	5(a&d)															
work/study procedures										1	3					
other(specify)																

	Total	%
a. reread/rehearse		
b. problem solve/question	10	16.9
c. relate/associate		
d. focus attention, concentrate		
a. & d. combined	24	40.7
e. fact-finding in text		
f. fact-finding in charts, graphs, maps, tables, etc. ..	5	8.5
g. following directions using text	1	1.7
h. following directions using charts, etc.		
i. special learning strategy (1.a.-d. above)		
j. repetition of reading task over days or months	5	8.5
k. single-trial learning	7	11.9
l. other(specify)		
m. usefulness for a particular task	3	5.1
n. whether to read more carefully later	4	6.8
o. whether to pass material on to someone else		
p. other(specify)		
total positive response	59	

Table 7: Specific strategies of tasks completed - Incumbents

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
work orders	4						1		(4)							
purchase orders						3										
invoices						3										
claims					2											
application forms						2										
schedules										1	1					
blueprints			1						(1)	4						
maps						3										
telephone directories						4										
dictionary											1					
catalogues										2						
textbook			2						(2)		1					
letters														1		
memos													3			
trade manuals	3		1						(3)	1						
company regulations			1						(1)				1			
contracts	1								(1)				1			
trade magazines													1	1		
examination questions																
safety & medical warnings										2						
material installation proced.										4						
tool & equipment directions										5						
work/study procedures										2						
other(specify)																

	Total	%
a. reread/rehearse	8	12.7
b. problem solve/question		
c. relate/associate	5	7.9
d. focus attention, concentrate		
e. fact-finding in text	2	3.2
f. fact-finding in charts, graphs, maps, tables, etc. ..	15	23.8
g. following directions using text	1	1.6
h. following directions using charts, etc.		
i. special learning strategy (1.a.-d. above)		
j. repetition of reading task over days or months	21	33.3
k. single-trial learning	3	4.8
1 other (specify)		
m. usefulness for a particular task	6	9.5
n. whether to read more carefully later	2	3.2
o. whether to pass material on to someone else		
p. other (specify)		
total positive response	63	

second; these two were barely reported by students. Therefore, it appeared that in both job components, subjects encountered a similar range and variety of specific strategies but most commonly employed different ones. In terms of the specific strategies involved with given reading tasks, students and incumbents agreed on seven of the fourteen mutually encountered, but disagreed on all five tasks most commonly encountered by both subject categories. Thus, it seems that the same important reading materials involve different reading processes in each job component.

Interim Summary

Based on the data gathered thus far, it was possible to examine the reading demands of the plumbing trade from several perspectives. One was to examine individual reading tasks in terms of the categories of profile dimensions subjects place them in, based on the total subject response and/or on the most common subject response. A second perspective was to examine the individual profile dimensions in terms of the number and variety of reading tasks in dimension categories, based on the total subject response and/or on the most common subject response. From both perspectives, the data provided by the total subject response was very detailed and provided for comparison of tasks within categories, dimensions, and job components. To compare task and profile dimensions between job components, generalizations were drawn from the most common subject response.

In order to summarize, then, it was possible to create a profile of all the reading tasks encountered in each job component, based on the most common responses in Tables 1-7. The following tables outline the and occupational reading tasks and demands. As the category indicated for each profile dimension was that most commonly chosen, the rating may be based on the response of one or two subjects in a job component. (The exception to this was the "frequency" category where the null response became a fifth category). In the tables, the numbers indicate "categories" and correspond to those on the page "Rating Categories for Task Checksheet". Thus, using Tables 8 and 9, it is possible to describe the curricular and/or occupational profile of a given reading task. For example, in the curricular setting, the task "application forms" had a complexity of "one-to-three page chart", a frequency of "less than once a month", was perceived to be "important but not vital", and was read for the purpose of completing a task with no learning, through the process of "fact-finding in charts, graphs, tables, etc." (Table 8).

Table 8: Profile for reading tasks encountered based on most common student response (curricular reading demands)

Tasks	complexity	frequency	perceived importance	general strategy	specific strategy
work orders		5			
purchase orders		5			
invoices		5			
claims		5			
application forms	5	1	2	2	f
schedules	5	1	2&3	3	j
blueprints	3	3	3	1	b
maps		5			
telephone directories	3	5	2&3	2	f
dictionary	2	--	2	3	k
catalogues		5			
textbook	1	4	3	1	(a&d)
letters		5			
memos	4	--	--	4	m
trade manuals	1	4	3	1	(a&d)
company regulations	4	5	2	4	m
contracts		5			
trade magazines	6	2&5	2	4	n
examination questions	6	3&4	3	3	b
safety & medical warnings	2	--	2&3	1	(a&d)
material installation proced.	1	2	2&3	1	(a&d)
tool & equipment directions	1	2	2&3	1	(a&d)
work/study procedures	4	4	3	3	k
other(specify)					

* Note "--" means no consensus; response too varied

( ) means used together

Rating Scale for Task Checksheet

Complexity:

1. entire book
2. part of a book/text
3. part of a book/chart
4. 1-3 page text
5. 1-3 page chart
6. other

Frequency:

1. less than once a month
2. once a week to once a month
3. 2-4 times per day
4. daily
5. never

Perceived Importance:

1. not important
2. important but not vital
3. vital to the completion of a task

General Strategies and Specific Strategies

1. reading-to-learn

    a. reread/rehearse
    b. problem solve/question
    c. relate/associate
    d. focus attention/concentrate

2. reading-to-do with no learning

    e. fact-finding in text
    f. fact-finding in charts, graphs, maps, tables, etc
    g. following directions using text
    h. following directions using charts, etc.

3. reading-to-do with incidental learning

    i. special learning strategy (1. a.-d. above)
    j. repetition of reading task over days or months
    k. single-trial learning: application of information'fixed'it
    l. other (specify)

4. reading-to-assess

    m. usefulness for a particular task
    n. whether to read more carefully later
    o. whether to pass material on to someone else
    p. other (specify)

Table 9: Profile for reading tasks encountered based on most common incumbent response (occupational reading demands)

	complexity	frequency	perceived importance	general strategy	specific strategy
work orders	4	4	3	3	a
purchase orders	5	--	3	2	f
invoices	5	2&5	3	2	f
claims	4	1&5	3	2	e
application forms	5	1&5	2&3	2	f
schedules	5	2&5	3	3	j&k
blueprints	3	1&2	3	3	j
maps	5	2&5	3	2	f
telephone directories	3	--	--	2	f
dictionary	2	5	2	3	k
catalogues	3	5	2	3	j
textbook	2	1&5	2	3	c
letters	4	5	2	4	n
memos	4	--	2	4	m
trade manuals	2	2	3	3	a
company regulations	4	5	2&3	3&4	c&m
contracts	2&4	5	2&3	3&4	a&m
trade magazines	6	5	1&2	4	m&n
examination questions		5			
safety & medical warnings	2&4	2&5	3	3	j
material installation proced.	--	--	3	3	j
tool & equipment directions	5	1&2	3	3	j
work/study procedures	4&6	5	3	3	j
other(specify)					

* Note "--" means no consensus; response too varied

In the occupational setting, the same task "application forms" had the same complexity of "one-to-three page chart" and involved the same general and specific strategies ("reading-to-do with no learning" and "fact-finding in chart, graphs tables, etc."); however, the frequency was divided between "less than once a month" and "never", and the perceived importance varied between "important but not vital" and "vital to task completion" (Table 9).

From the tables, some observations were made about individual reading tasks and about composite reading demands within and/or between job components. To begin with, some specific conclusions were made. First, the "variety" of reading tasks was greater in occupational reading than in curricular reading; also the variety was somewhat different, with fourteen tasks being mutually encountered, but one exclusive to students and eight exclusive to incumbents. Second, the range of "complexity" categories encountered was less in occupational reading than in curricular reading; and the most common complexity category was different: the "entire book" for students and "one-to-three page chart" for incumbents. Third, the "frequency" of reading tasks varied within and between job components: the number and variety of tasks in frequency categories differed between job components; the range was less for vocational reading demands; and for very few reading tasks was an absolute frequency established. Fourth, the majority of reading tasks encountered in both job components were perceived to be "vital to task completion", with a significant number being "important but not vital". Fifth, the range of "general strategies", tasks in general strategy categories, and most common general strategy category were all different between job components; the same held true for specific strategies. More generally, fourteen of the tasks listed had both curricular and occupational profiles, and for none of the tasks were the two profiles exactly the same. In particular the five most commonly encountered tasks (blueprints, textbooks, trade manuals, material installation procedures, and tool and equipment directions) had almost completely different profiles (the exceptions were that blueprints were rated as being of the same complexity, and blueprints and trade manuals, of the same perceived importance in both job component). This reinforced the idea that curricular and occupational reading could be very different.

Question 3: Difficulty of reading materials

> How difficult were the materials read in each job component; ie. at what approximate grade level were representative materials written, and was there a discrepancy between the ability of the subjects and the ability level demanded by the material?

For the majority of reading materials involved in this study, it was almost impossible to determine the reading difficulty. Readability formulae, which at best provide only an estimation of difficulty, have not been developed to process examination questions, forms, charts, tables, graphs, catalogues, and blueprints, ie. the majority of reading materials encountered in the trade. Therefore, the assessment of the reading difficulty level of plumbing-related materials was limited to those tasks which contained portions of connected discourse. This effectively excluded six of the fifteen curricular reading tasks, and ten of the twenty-two occupational reading tasks - those with a complexity of "part of a book/chart", "one-to-three page chart", and "other". More specifically, it eliminated five of the thirteen reading tasks most commonly encountered by students (three-to-five subjects) and six of the eleven reading tasks most commonly encountered by incumbents (three-to-five subjects). Those remaining were either occupational materials used as curricular materials and vice versa (trade manuals, material installation procedures, textbooks, safety and medical warnings, tool and equipment directions), or of such a varied and individualized nature as to be beyond assessment (dictionaries, work orders, memos, work/study procedures). Therefore, of necessity, this discussion centered on a limited number of the reading tasks found in the plumbing trade, but these materials were encountered coincidentally in both the curricular and occupational settings.

With that in mind, then, there was great similarity in the difficulty of important reading materials between job components. However, there were other reading tasks reported to be completed only by subjects in separate job components; for example, examination questions for students and work orders for incumbents. As noted earlier, it was almost impossible to assess the difficulty of many of the commonly encountered reading materials, particularly these two. However, it may be speculated that the nature of reading processes involved in taking examinations is more complex and lengthy, thereby making exams significantly more difficult than work orders. Students may thereby encounter some reading tasks at a higher difficulty level than incumbents. Although students more frequently encounter those materials assessed by formula, this doesn't really affect the difficulty level of curricular reading.

For assessment purposes, then, portions of only those most commonly encountered reading tasks free of the above restrictions were examined. To answer the first part of the question, a variety of reading materials

Table 10: Reading level of selected materials
(based on FORCAST Formula*)

Selected materials	Mean grade lel (based on 3 paages)
1. Apprenticeship Training: Plumber Program 1976. Alberta Advanced Education and Manpower, Apprenticeship and Trade Certification Branch. (52 pgs.)	12.23
2. Apprenticeship Opportunities. Alberta Advanced Education and Manpower. (4 pgs.)	10.56
3. Water Treatment Review. Medicine Hat College. (10 pgs.; instructor - made notes; summary of Alberta Agriculture publication)	11.70
4. Treatment of Farm Water Supply. Alberta Agriculture (31 pgs.; copy used as notes in apprenticeship program)	10.1
5. Private Sewage Disposal - 3rd and 4th Year. Medicine Hat College. (36 pgs.; copy of Alberta Agriculture publication, used as notes)	10.8
6. "Dugout Float Intakes" et al. Agrifax. Alberta Agriculture, 1977-78. (twelve 1-3 pg. pamphlets; used as notes)	10.1
7. Home and Farm Water Supply Manual. Alberta Agriculture (reproduced from an original by F.E. Meyers and Bros. Co., 1963, 53 pgs.)	10.6
8. Private Sewage Disposal Systems: Information Installers 1982. Alberta Labor, General Safety Services Division, Plumbing and Gas Safety Services Branch. (38 pgs.)	9.9
9. The Plumbing and Drainage Act Regulations. Alberta Labor, General Safety Services Division, Plumbing Inspection Branch, 1977. (63 pgs.)	10.0
Grand Mean	10.

* US grade = 20 - (NOSW ÷ 10)
Number Of Single Words in a 150-word passage of connected disse

were subjected to the FORCAST readability formula, Table 10. Nine different reading sources were determined to have a mean of grade 10.7, and a range of grade 9.97 to 12.23. This grade level would seem to be a little higher than would be recommended, as grade nine is the educational prerequisite for most trades programs. However, this can not be stated unequivocally because the only prerequisite to the plumbing apprenticeship program is successful completion of the entrance examination. If an educational prerequisite were to be established, grade ten or eleven would appear to be most realistic.

To answer the second part of the question, a procedure was instigated to ascertain the degree of difficulty presented by vocational reading materials. The purpose was not to measure the reading level of the material, or to measure the reading ability of the subjects; rather, the purpose was to determine if a discrepancy existed between the ability of the subjects and the level demanded by the materials (ie. the degree of ease with which the subjects could process the material). Three reading articles were selected from the representative materials assessed for "readability" level. For each of the selections, major and minor points in the "message" were identified, and subjects explained those points from each selection which they could recall and articulate. The verbalizations were recorded, transcribed and analyzed. The percentage of major and minor points acceptably paraphrased was tabulated for each selection, in Appendix D:6. Table 11 provides an abbreviated profile of the curricular form of those tabulations; the mean percentage of major and minor points acceptably recalled and verbalized for each selection have been combined.

Table 11: Points recalled in verbalizations (mean percentage of major and minor points recalled)

Article	A "Subsurface Disposal Fields"	B "Code Regulation"	C "Pressure Tanks"
1. All subjects	45	27	35.5
2. Students only	44	28	35.5
3. Incumbents only	47	25	37.5

In order to make a judgment about the difficulty readers appeared to experience, the same criteria was used as is employed with the cloze procedure of readability/reading ability assessment (Bormuth, 1966, 1975). According to that procedure, the percentage of correct "answers" determines the level at which the reader interacts with the material: 0% to 40% correct is the "frustrational" level at which the material is too difficult; 40% to 60% correct is the "instructional" level at which instruction and/or assistance is needed for successful reading; and 60% to 100% is the "independent" level at which the material appears to present no problems (Vacca, 1981). Against this criteria, then, selections B and C were both at the frustrational level and selection A was just above that. This appeared to indicate that the materials were difficult for the readers to comprehend and/or recall.

An alternative to the consideration of the percentage of major and minor points recalled as a measure of reading difficulty was to examine the verbalizations for that which was "positive" and contributory versus that which was "negative" and detracting. Each verbalization contained some "additions" which appeared to be "filler" as subjects sought to explain what they had read. It was felt that a large percentage of "negative" verbalization might indicate a reader's difficulty with the selection. Therefore, each verbalization was divided into that considered to be positive (major and minor points acceptably paraphrased plus consistent additions) and negative (major and minor points unacceptably paraphrased plus inconsistent additions). This data was tabulated in Appendix D:7. Table 12 provides an abbreviated form of that tabulation and prompts the following observations.

Table 12: Mean percentage of total verbalization considered to be "positive"

Article	A	B	C
	"Subsurface Disposal Fields"	"Code Regulation"	"Pressure Tanks"
1. All subjects	82.7	34.6	80.3
2. Students only	95.8	44.4	78.4
3. Incumbents only	65.1	21.6	82.9

Since the mean percentage of total verbalization connected with Article B was noticably more negative than positive, and the reverse was true for Articles A and C, it might be concluded that B presented more problems for subjects than did A or C, and that A and C presented only "some" problems. It is interesting to speculate on the reasons for selection B presenting problems. It had fewer major and minor points than A or C; perhaps it was difficult to recall a high percentage of points when the variety or range was not as great to choose from. Most likely, the nature of the selection was a contributing factor: selection B contained numbers and equations to be remembered, while A and C did not; and the legal terminology and style of the code book from which B was taken was more formal than that of A or C. On a different note, students appeared to handle Articles A and B considerably better than did incumbents. No reason for this is readily apparent, although the intense exposure students receive to these materials may make students more at ease than are incumbents.

In summation, it appears that the readers of the materials had difficulty with what they encountered. However, the exact relationship between what the reader reads, recalls and understands is not known (see Limitations, Chapter 5).

Question 4: Significance of reading

> What was the significance of reading to the job component, in terms of time spent reading, use of alternatiave strategies (ie. information sought from non-print sources in completeting a task that could be completed with the use of printed material), and general attitude toward reading?

To estimate the amount of time subjects spent reading in each job component, a direct question was asked on the Attitude Questionaire (Appendix A). In response to the statement "During a usual day, I spend about ____ minutes reading for my job" (Question 7, Attitude Questionaire), students reported doing an average of 2.8 hours per day and incumbents reported an average of 25 minutes or .42 hours per day (see Appendix A:2). In terms of a six-hour class day, students spend a considerable portion reading; in terms of an eight-hour working day, incumbents spend a very small portion reading. As compared to incumbents, it appeared that students may spend six-to-seven times longer per day reading. Observation of the subjects indicated that, in fact, both subject categories might have been spending slightly more time reading than they had reported. A variation from day to day was noted, particularly among incumbents where the amount of time spent reading varied greatly depending on the type of plumbing job held (service and maintenance, commercial, residential or management); however, in-depth analysis and comparison of reading in different types of plumbing jobs was beyond the scope of the study. In summation, in terms of time involved, reading was more significant in the curricular setting than in the occupational setting. As well, as a portion of a total working day, reading was highly significant to the curricular job component and much less significant to the occupational job component.

To ascertain whether or not alternative strategies were often used by subjects, again a direct question was asked on the Attitude Questionaire. In response to the statement "On the job, if I wanted to know something and I knew it was in a book, I would: look it up; ask somebody else; forget it; or _____ "(Question 6, Attitude Questionaire), all five students and four of the five incumbents chose to "look it up" (see Appendix A:3 and A:4). This was essentially verified by observation; subjects often referred to reading materials in completing a task. Interestingly, the one plumbing incumbent who chose to "ask somebody else" was a new Canadian who did not feel competent with the English language. It appeared, then, that alternative strategies were not often used, ie. information was not often sought from non-print sources in completing a task that could be completed with the use of written materials. Although no reasons were explicitly stated, it may be speculated what the reasons were for each subject category. For incumbents, it may have been the nature of the information needed - usually facts in tables or text, or the nature of the job - working in isolation from other plumbers. Since the work is exacting, it may be easier and less costly to "do it right the first time." For students, it may have been the fact that they are expected to know by rote much or most of the trade manuals, and might as well "get it right" before committing the information to memory.

Finally, in terms of the general attitude toward reading, observations were made from response to the Attitude Questionaire (see Appendix A:3 and A:4). All ten subjects reported that, in their job, reading was "very important", and that they could not do their job well without reading at all (Questions 1 and 10, Attitude Questionaire). With the reading done on the job, two from each category were "very comfortable" and three were "sort of comfortable" (Question 2). Three students and one incumbent reported "often" reading for personal enjoyment and relaxation (Question 4). Reading job-related literature outside of working hours was reported done "often" by one subject from each category and "sometimes" by four from each. Three subjects from each category reported desiring help with some of the specialized reading they encountered. From these responses, it was concluded that neither students nor incumbents had a negative attitude towards reading. The only differences in attitude appeared in the perception individuals had of their own ability: whereas all five incumbents considered themselves "average" readers, only three did, with one rating himself "above average" and one "below average". As well, two students felt that reading problems could hold them back from promotion, but the only incumbent who reported the same thing was the new Canadian whose ability in English was questionable. It appeared, then, that students experienced more anxiety about reading and their ability than did incumbents. In summation, subjects judged reading to be highly significant to their jobs.

Interim Summary

Between job components, there appeared to be significant differences in the reading demands. Students spent much more time reading and applied different strategies than incumbents, often to the same reading materials. Since many materials were used in both job components, the reading difficulty level was basically the same; however, students may have encountered some reading tasks at a higher difficulty level (examination questions) and more of the higher difficulty materials (the positive responses to the frequency of assessed reading tasks were greater in number for students than for incumbents). As well, each subject category encountered some reading tasks not at all encountered by the other. More students reported encountering reading tasks; and students reported more "most commonly encountered" reading tasks and a greater range of complexity for the "most commonly encountered" reading tasks. Between students and incumbents, there appeared to be different "most commonly encountered" reading tasks, different most frequently encountered complexity categories, different numbers and variety of reading tasks in importance categories, and different distribution of tasks in frequency categories. Students reported completing a majority of "reading-to-learn" tasks and incumbents reported a majority of "reading-to-do with incidental learning" tasks. As well, the usage of specific strategies was different in each job component. With regard to time involved, reading was less significant in the occupational job component than in the curricular component. However, in terms of the use of alternative strategies and attitude of the subjects, reading appeared to be highly significant to both job components.

Question 5: Functional reading instruction

> Was there evidence of functional reading instruction with regard to curricular materials and/or occupational reading materials?

For purposes of this study, "functional reading instruction" meant the direct or indirect teaching of reading skills using content area materials (see Chapter 2). It involved such things as general reading and study skills, vocabulary and concept development, comprehension, and subject-specific reading skills. To examine functional reading instruction within the plumbing apprenticeship program, students and instructors responded to the Functional Reading Questionaire (Appendix E:1) which covered the four general areas listed above. Subject response to that questionaire was tabulated in Appendix E:2 and the following observations made. It should be noted that only actual students were considered to be subjects in this study (see Chapter 3, p. 42); therefore, the response of teachers/instructors was provided only for the sake of comparison.

To begin with, there appeared to be little concern for general reading and study skills. Of students, (66.7%) reported that the student's reading ability was "almost never" formally tested with a reading test at the beginning of a course (Question 1); and 77.8% reported that the student's reading problems and study routines were "almost never" discussed informally at the beginning of a course (Question 2). The response to the usage frequency of teacher-constructed reading guides, before and during reading (Question 7), and of formalized study strategies, before, during and/or after reading (Question 3), was scattered, with the least positive response in the "almost always" category. It appeared, from this, that there was very little direct teaching of reading or study skills in the curricular component of the trade.

More specifically, there appeared to be only "some" concern for vocabulary development. Approximately half of the subjects reported questions or discussion about new words and their definitions before a reading assignment (Question 8), or after a reading assignment (Question 10). However, 77.8% of students reported "almost never" having questions, either written or verbal, about new words and their definitions during a reading assignment (Question 9).

As with vocabulary development, there appeared to be limited concern for concept development. Of students, 77.8% reported that the student was "sometimes" given questions or directions, before a reading assignment, about how this new information would fit in with what he had already learned from that course, other courses, or perhaps on the job (Question 13). 55.6% reported that the student was "sometimes" given questions or directions, during or after a reading assignment, about how that new information would fit in with what he had already learned (Questions 14 and 15). Seldom, then, was there diagnosis of conceptual background and/or instruction in concept structures and relationships.

In contrast, there appeared to be more concern for comprehension. Most emphasis appeared to be placed on the literal level of comprehension: all the students reported encountering questions, during and after a reading assignment, that required a memorized answer (Questions 18 and 19). At the interpretive level, only "sometimes" did students report "fitting" new information in with what was already known (55.6% on Questions 14 and 15); and less often did they have to interpret new information into their own words - 44.4% "sometimes" and 44.4% "almost never" during a reading assignment (Question 20), and 55.6% "almost never" after a reading assignment (Question 21). At the applied level, 62.5% reported "sometimes" encountering questions during a reading assignment that expected the student to apply the new information to a problem or different situation (Question 22); and 66.7% reported "often" applying the new information after a reading assignment (Question 23). Significant emphasis seemed to be placed, then, on students comprehending what they read.

Finally, the concern for specific curricular and/or occupational reading skills instruction appeared to be variable. When asked how often the student was given direct instruction in reading specific work-related or school-related materials, student's response was scattered (Questions 24 and 25). The clearest response was that 44.4% reported "often" receiving direct instruction in reading school-related materials, which were 44.4% reported to be "often" different from work-related reading (Question 26) and 55.6% reported to be "often" given more emphasis that work-related reading (Question 27). Work-related reading was reported 66.7% to be "almost never" given more emphasis than school-related reading (Question 28).

In answer to the research question, then, there was evidence of some functional reading instruction with regard to vocational reading materials of the plumbing trade. Instruction was primarily with regard to curricular materials and came in the form of comprehension questions after the reading assignment, rather than diagnosis and/or direct skills instruction before or during the reading assignment.

Question 6: Reading-related problems

Did any reading-related problems readily present themselves?

Within the educational component of the plumbing apprenticeship program, no major reading-related problems became apparent. As a medium of instruction, reading appeared to be no more significant than the lecture and/or discussion modes: 55% of students reported "sometimes" having new and review information presented in a lecture, with little or no reading involved (Question 4, Appendix E:2); 44% - "sometimes" and another 33% - "often" having the same information presented in both a lecture/discussion and a reading assignment (Question 5); and 55.6% - "sometimes" having new and review information presented in the form of a reading assignment only (Question 6). Whether or not this presented problems for students was indeterminate from the scattered response to questions on the frequency that students asked about new words, or asked for an explanation of most or all of what had been read, during or after a reading assignment (Questions 11, 12, 16 and 17).

However, it is possible that problems may be evidenced by the different views that students and instructors had about reading in the classroom. Of possible significance are the discrepancies between student's and instructor's responses to the functional reading questionaire. In some cases, there was essential agreement between students and instructors, most notably about the lack of diagnosis of reading competence and instruction in formal study strategies. However, it may be seen in Table 13 that, in general, instructor's responses were predominantly more positive that are student's.

Table 13: Response to Functional Reading Questionaire

		almost always	often	sometimes	almost never
students	# (N=251)	28	71	77	75
	%	11.2	28.3	30.7	29.9
instructors	# (N=56)	24	13	10	9
	%	42.9	23.2	17.9	16.1

This difference in perception may present a problem if instructors and students feel differently about the adequacy of the amount of instruction; this, however, was unclear from the questions asked.

Finally, a problem seemed to be indicated by the attitude subjects had towards reading in each job component (Appendix A:3 and A:4). For each category, three of the five subjects were only "sort of comfortable" with the reading done, and three of the five desired help with the specialized reading they encountered.

SUMMARY

Based on the data gathered by questionaires and by observation, the findings of this study were numerous. Both general observations and very specific conclusions were made in four broad categories:

1. curricular and/or occupational profiles of individual reading tasks;
2. curricular and occupation profiles of the reading demands;
3. other dimensions of curricular and occupational reading demands; and
4. vocational reading in the curricular setting.

In examining the profiles of individual reading tasks, the following observations were made.

1. Based on total subject response to all of the tasks listed, one task (examination questions) was exclusive to curricular reading, eight were exclusive to occupational reading, and fourteen were encountered in both job components; of the fourteen, the five most commonly encountered (by 80 - 100% of the subjects) were blueprints, textbooks, trade manuals, material installation procedures, and tool and equipment directions (Table 1).
2. Based on the total subject response, the rating of profile dimensions for any given reading task could vary within and/or between job components (Tables 2-7); however, for most, there was a most common subject response within job components (Tables 8 and 9).
3. Based on both total subject response and most common subject response, none of those fourteen mutually encountered reading tasks had identical curricular and occupational reading profiles, and all five most commonly encountered tasks had almost completely different curricular and occupational profiles (Tables 2-9).

4. Based on the most common subject response, the "complexity" rating of eighteen reading tasks was the same in both curricular and/or occupational reading; however, four of the five most commonly encountered tasks had completely different complexity ratings between job component (Table 2).
5. Based on the most common subject response, the "frequency" rating for eighteen of the twenty-three tasks varied within and/or between job components; between job components, there was partial consensus for only one of five most commonly encountered tasks; within job components, there was consensus for only nine of twenty-two occupational reading tasks and ten of fifteen curricular tasks (Table 3).
6. Based on the most common subject response, the "importance" rating was basically the same for eleven of the fourteen mutually encountered tasks; four of the five the most commonly encountered tasks were mutually rated "vital to the completion of a task"; and the perceived importance of only six curricular and five occupational reading tasks varied within job components (Table 4).
7. Based on the most common subject response, the "specific strategy" rating of seven mutally encountered tasks and all five most commonly encountered tasks was different between job components (Table 6).

In examining the curricular and occupational reading demand profiles, the following observations were made.

8. Based on both total subject response and most common subject response, there were some similarities and differences in the curricular and occupational reading demands of the plumbing trade.

9. The variety of tasks encountered was greater in occupational reading than in curricular - twenty-two as opposed to fifteen tasks; however, the variety of most commonly encountered tasks was very similar between job components - thirteen in curricular reading and eleven in occupational reading (Table 1).

10. Based on both total subject response and most common subject response, the range of complexities encountered was greatest in curricular reading (all six as opposed to five in occupational reading) and the most frequently encountered complexity category was different - "entire book" for curricular reading, "one-to three page/chart" and "one-to-three page/text" for occupational reading (Tables 2, 8 and 9).

11. Based on total subject response (positive and negative), the range of frequency categories encountered was the same for reading in both job components (all categories) and the most frequent "frequency" category was "never" for reading in both job components (Table 3); based on most common subject response, the range of frequency categories was less in occupational reading - no "two-to-four times per week", and the most commonly encountered tasks in frequency categories differed significantly between job components (Table 8 . and 9)

12. Based on total subject response, the range of "perceived importance" categories encountered (all three) and the most frequent category ("vital to the completion of a task") were the same for reading in both job components (Table 4); based on most common subject response, the range was less in curricular reading (no "not important" tasks) (Table 8 and 9).

13. Based on both total and most common subject response, the range of "general strategy" categories encountered in curricular reading was all four categories and the most frequently encountered was "reading-to-learn", while in occupational reading, the most frequently encountered category was "reading-to-do with incidental learning" and the range decreased from all four to only two (Tables 5, 8 and 9).

14. Based on both total and most common subject response, the range of "specific strategy" categories encountered was approximately the same in both job components (Tables 6, 7, 8 and 9); the most frequently encountered category was different between job components - "reread/rehearse and focus attention/concentrate combined" in curricular reading and "repetition of reading task over days or months" and "fact-finding in charts, etc." in occupational reading; and the tasks encountered in "specific strategy" categories were mostly different between job components.

With regard to other dimensions of the curricular and occupational reading demands, the following observations were made.

15. Alternative strategies (information sought from non-print sources in completing a task that could be completed with the use of written materials) were very seldom employed in either job component (Appendixes A:3 and A:4)

16. The time spent reading in the curricular setting was significantly greater than that in the occupational setting, perhaps by six or seven times (Appendix A:2)

17. The difficulty level or "readability" of the materials encountered was about the same between job components because most of the curricular reading materials were essentially occupational material used in the curricular setting; however, the complexity and frequency of encounters with those materials was greater in curricular reading; and some potentially more difficult tasks may have been encountered in the curricular setting (examination questions as opposed to work orders).

18. Subjects from both job components experienced some difficulty reading and/or recalling the messages of representative reading selections; and students appeared to have less difficulty than incumbents (Appendix D:6).

Finally, in examining the role and treatment of reading in general, and vocational reading in particular, in the curricular setting, the following observations were made.

19. In the curricular job component, there appeared to be very little direct teaching of reading and/or study skills; as well, there was limited concern for vocabulary and/or concept development; and the functional reading instruction most evidenced took the form of comprehension questions after a reading assignment (Appendix E:2).

20. There was some direct instruction in the reading of blueprints, the only occupational reading task to be so considered; and there was limited direct instruction in the reading of examination question, the only curricular reading task to be so considered.

21. Some reading-related problems became evident; there were discrepancies between the instructor's and student's perception of the role and treatment of reading in the curricular setting; as well, subjects admitted to desiring help with some of the specialized reading they had to do and to feeling only "sort of comfortable" with the vocational reading demands; and reading materials appeared to be difficult for the subjects.

Chapter 4 contains an analysis of the data gathered through interviews with and observation of plumbing students and incumbents. For all of the reading tasks listed, curricular and/or occupational profiles were drawn: first based on the total subject response to each dimension category (Tables 2-7), and then based on the most common subject response (Tables 8 and 9). Further to this was a discussion of the additional dimensions of difficulty of materials, time spent reading, attitude of the reader, and use of alternative strategies. An examination of the similarities and differences in reading demands between the two job components constituted the primary purpose of the study. The secondary purpose, an examination of the role and treatment of reading in the curricular setting, was served by a discussion of the implications arising from the extent and nature of functional reading instruction in the apprenticeship program, and of the readily-apparent reading-related problems.

CHAPTER FIVE

SUMMARY AND CONCLUSIONS

This study was an investigation of the vocational reading demands of the plumbing trade. It had two purposes, each addressed by separate research questions, each involving different data gathering instruments and procedures, and each providing for observations and tentative conclusions.

The primary purpose was to compare the curricular reading demands encountered by plumbing apprentices in the educational situation with the occupational reading demands encountered by journeymen in the actual incumbency situation. For this study, "reading demands" meant a composite of the variety, complexity, frequency, perceived importance, strategies and difficulty of reading tasks encountered. "Variety" was the number and name of reading tasks reported encountered by subjects; "complexity" referred to the format or type of display of a reading task; "frequency" was the time segments in which the tasks were encountered; "importance" referred to the significance of a reading task to successful job/task completion; "strategies" were the general purposes and specific processes involved with reading materials; "difficulty" was both an approximate reading grade level and the reading skill level demanded by the material relative to the competence of the intended readers. To these dimensions of the reading tasks was added the significance of reading in terms of time involved, use of alternative strategies, and general attitude towards reading. To accomplish the primary purpose, the reading demands of each job component were first determined through interviews with and observation of plumbing students and incumbents. The instruments and procedures used to gather data were: an attitude questionaire (Appendix A) completed by subjects during the initial interview; a task checklist (Appendix B) which was partially completed through an interview with individual subjects, then verified and amplified through observation of the subjects (Appendix C); an informal readability assessment (Appendix D) completed during a second interview with subjects; and a formal assessment of some representative reading tasks using the FORCAST readability formula (Caylor et al., 1973). Once the profiles of the individual reading tasks and composite reading demands had been determined within each job component, similarities and differences between job components were discerned.

The secondary purpose of the study was to examine the role and treatment of reading, as both an educational tool and a vocational skill, in the curricular setting. Data was gathered through a questionaire (Appendix E) completed by students and instructors, and through observation in the classroom. Observations and tentative conclusions reflected a concern for content area reading instruction and reading within vocational education.

As a foundation to this study, a review of the literature pertaining to functional/occupational literacy, content area reading instruction, readability assessment, and vocational education revealed numerous reading-related issues and concerns. In general, there was evidence to suggest that reading is an important occupational skill (Diehl, 1980; Murphy, 1975; Sharon, 1973; Sticht et al., 1971-1978), but it was not known to what extent this was the case for any given vocation, and for the plumbing trade specifically. As well, studies had shown the reading demands while training for a job to be different from reading demands in the actual job incumbency (Diehl & Mikulecky, 1980; Mikulecky, 1981; Moe et al., 1979; Ross, 1980; Sticht, 1978); this has led to serious implications for the training program where prospective tradespeople are supposed to be instructed in the skills required for successful job completion (Lee, 1981; Thornton, 1979). Further to that, studies in the field of content area reading instruction revealed that reading-related problems can be and often are presented by the reading materials, the students, the instruction and/or combinations thereof (Cheek & Cheek, 1981; Conroy, 1980; Herber et al., 1961-1979; Manzo, 1980; Readance, Baldwin & Dishner, 1980; Riley, 1979; Smith, 1976; Stansell & DeFord, 1981; Thelen, 1979; Thornton, 1977; Vacca, 1981). Finally, studies in readability assessment pointed to the difficulty in assessing the reading level of materials and attempting to match materials to intended users (Abram, 1981; Anderson & Armbruster, 1981; Curran, 1976; Diehl, 1980; Harrison, 1980; Horne, 1979; Irwin & Davis, 1980; Jacob & Crandall, 1979; Klare, 1974; Maxwell, 1978; Vacca, 1981). This study was, therefore, an attempt to tie together four distinct yet inter-related academic fields. It was, in part, an attempt to identify the vocational reading demands of the plumbing trade; ie. the dimensions of the actual reading tasks encountered. As well, it was an examination of the current treatment of reading within the apprenticeship program as it related to the actual demands encountered in separate job components, to the potential reading-related problems, and to issues in content area reading instruction.

LIMITATIONS AND DELIMITATIONS

It is recognized that a number of limitations exist which restrict the conclusions and generalizability of this study. To begin with, this study was conducted at only one of the ten educational institutions which offer trades apprenticeship programs in Alberta. However, it was assumed that the programs must be essentially the same as there is a common provincial examination for each trades area, and there is a provincial advisory committee to oversee the programs. As well, it was assumed that students do not differ vastly from institution to institution, as entrance qualifications are standard across the province. The most significant difference between institutions would be made by individual instructors, the analysis of which was beyond the scope of this study. Limitations to the study were further imposed by the variety of employment situations journeymen plumbers may be engaged in. It is conceivable that the responsibilities and demands of the plumbing-related jobs differ according to size and scope of the employment establishment, the size and nature of the residence locale, attitudes of employers and fellow employees, length of time on the job, and type of plumbing job held (service and maintenance, commercial, residential, or management). It was intended that the sample for this study be representative of the variety of plumbing jobs.

Further limitations may be imposed by the self-report method of data collection. Mikulecky and Diehl (1979) noted that people are often unaware of the reading they actually do on the job and fail to report many literacy activities because they are so much a part of the occupational task. To this, Jacob and Crandall (1979) added that people have different conceptions of what reading is: filing, chart reading, skimming documents for answers to telephone questions are not always seen as "reading". As it is important to verify people's conceptions of reading as well as their impressions of what they read, the amount of time they believe they read, and the purposes for which they read, the observation phase of the procedure was an attempt to verify and amplify the self-report data.

Another set of limitations was imposed by the current methodology for determining the difficulty of job literacy materials. The most common approach has been to determine the readability level using a formula. Caylor et al. (1973) developed the FORCAST formula for use with job materials, but as with all formulae, it has severe restrictions. Therefore, it was used only to give an indication of difficulty. Further to that, there were limitations in using the unaided recall procedure to assess the match between reader ability and material difficulty. The extent to which prior knowledge influences the subject's response is unknown, but subjects indicate that it may be influential, even critical. As well, it was difficult to determine whether inaccuracies in "recalled" information were problems in reading/comprehending, remembering/recalling, or articulating. In addition to these limitations, there were a number of delimitations to this study. First, the pre-journeyman phase involves four stages of advancement, but they were not considered separately. Representatives were drawn from the last stage, fourth-year apprenticeship, as it was assumed to demand the most advanced use of skills inherent in the educational situation. Secondly, instructors, employers and supervisors were not involved in this study. Whereas Smith (1976) concluded that skill data may reliably be obtained from either workers or their immediate supervisors, other researchers had concluded that supervisors under-report literacy activities and forms (Jacob, Crandall & Scribner, 1979; Mikulecky, 1981) or list extensive reading materials which are available but never or rarely used by incumbents (Caylor et al., 1973). Therefore, to prevent such problems, only actual plumbing apprentices and journeymen were involved, except in one small instance. Finally, this study was not an attempt to determine the level of functional or occupational literacy demanded by the plumbing trade, as literacy involves all communication and computation skills (Kirsch & Guthrie, 1980). It was not an attempt to determine the occupational literacy of the tradespeople, as literacy is influenced by a number of extra-linguistic variables: the context of the reader's interaction with print, the reader's attitude and motivation to read, the rewards or lack thereof of completing the literacy task, and the frequency of the task (Diehl, 1980). It was not an attempt to measure, determine or predict functional or occupational competence, as a measure of skills is not a sufficient indicator of the occupational competence of an individual or population (Kirsch & Guthrie, 1980; Mikulecky & Diehl, 1979). It was simply an attempt to determine the actual and specific reading demands involved in the plumbing trade, using as comprehensive and uncontroversial a methodology as possible.

CONCLUSIONS AND IMPLICATIONS

From the results of this study, conclusions were drawn about the curricular, occupational and vocational (combined) reading demands of the plumbing trade. Further conclusions were drawn about the role and treatment of reading in general and vocational reading in particular, in the curricular component of the trade.

To begin with, it was possible to outline the curricular and occupational reading demands of the trade. In the curricular job component, a variety of at least fifteen different reading tasks were reported; and tasks were encountered in every category of every dimension except "specific strategy". Thus, the curricular reading tasks were of very diverse complexities, frequencies, and importance, and involved very diverse purposes and processes. In the occupational job component, a variety of at least twenty-two different reading tasks were reported; but tasks were not encountered in every category of every dimension. Thus, the occupational reading tasks were of less diverse complexities, frequencies and importance, and involved fewer purposes and processes. As the vocational reading demands of the plumbing trade are a combination of the curricular and occupational reading demands, it was concluded that for vocational reading, the variety was at least twenty-three tasks: tasks in every dimension category. In vocational reading, tasks were of every complexity (entire book; part of a book/text; part of a book/chart; one-to-three page text; one-to-three page chart; and other); every frequency (less than once a month; once a week to once a month; two-to-four times per week; and daily), and every perceived importance (not important; important but not vital; and vital to the completion of a task), and involved every purpose (reading-to-learn; reading-to-do with no learning; reading-to-do with incidental learning; and reading-to-assess) and almost every specific strategy (reread/rehearse; problem solve/question; relate/associate; fact-finding in text; fact-finding in charts; application of special learning strategies; repetition over days or months; single-trial learning; assessing for the usefulness for a particular task; and assessing whether to read more carefully later). As well, in both the curricular and occupational job components (hence, the entire vocation), considerable time was spent reading, alternative strategies were seldom used, reading was considered important, and subjects had a positive attitude towards reading. In summation, the reading demands of the plumbing trade appeared to be far more diverse and significant than is commonly believed; reading is an important vocational skill in the plumbing trade.

The vocational reading demands of the plumbing trade involved a combination of the curricular and occupational reading demands; however, there were important differences between the two. In occupational reading, the variety was greater but the range of categories encountered for each dimension was less than in curricular reading; as well, the most commonly encountered dimension categories were different. Although fourteen tasks were mutually encountered in both job components, the curricular and occupational profiles of each were never identical and often very different across dimensions. As well, the curricular and occupational profiles of the five most commonly encountered tasks were almost completely different across profile dimensions. Too, the amount of time involved was significantly different between job components.

This appears to support the theory that the curricular reading demands of a trade can be very different from the occupational reading demands of the trade, in terms of the use of information gained, and the nature and frequency of tasks encountered (Diehl & Mikulecky, 1980; Mikulecky, 1981; Moe et al., 1979; Ross, 1980; Sticht, 1978).

Besides differences, there were also important similarities between the curricular and occupational reading demands which together comprise the vocational reading demands of the plumbing trade. First, the same materials were often used in both job components, and the representative samples of these materials appeared to be somewhat difficult for subjects to comprehend and/or recall. Second, both reading and learning appeared to be very important in both components of the plumbing trade. In curricular reading, the most common purpose was to learn (the individual applied strategies designed to ensure retention of the material read); in occupational reading, the most common purpose was to complete a task but learn the material in the process so that it ceased to function as an external memory; and there was a minimum of "reading-to-do with no learning" tasks in both job components. This contradicts the notion that the literacy demands for job performance may have been overestimated (Jacob & Crandall, 1979); if anything, they are underestimated. This has implications for the standards and prerequisites to apprenticeship programs, and for individual's career planning (ie. plumbing is not just a manual labor job).

What most clearly becomes apparent is that, for all intents and purposes, the educational/apprenticeship component of the plumbing trade may be primarily a "reading" program. Plumbing apprentices spent a great deal of time reading or learning to read a large variety of materials. Reading may be vastly more important in the curricular setting than in the occupational setting: students most commonly read materials of a greater complexity ("entire book" as opposed to "one-to-three page chart", Table 2); and students read for longer periods of time (Appendix A:2). In fact, students spent most of the class time during a six-week apprenticeship program doing literacy activities. This was directly contrary to the incumbency situation where literacy activities took a very small portion of a working day. If reading is so much more important in the curricular setting, perhaps more concern should be shown for student's ability and material's suitability than is currently the case. It was simply expected that students be able to handle such school-related tasks as application forms, schedules, dictionaries, memos, examination questions, and study procedures, almost as a prerequisite to entrance. As well, such work-related tasks as blueprints, trade manuals, safety and medical warnings, material installation procedures, and tool and equipment directions were used as curricular materials, and students were simply expected to "read" them. The emphasis, for all tasks except blueprints, was on what the materials said rather than on how it was said. This effectively made instructors into "interpreters" and kept students dependent on them. Finally, in the curricular setting, absolutely no mention appeared to be made of the eight further tasks reported exclusively encountered by incumbents. The conclusion from this was that, for the most part, the vocational reading demands of the plumbing trade were not treated as a concern in the curricular setting.

Further to that, a great deal of student time was devoted to learning the trade manuals/code books from cover to cover: they are the undisputed source of correct procedures and regulations. This practice appeared to have been for the purpose of passing the trade certification exams; thereafter, the plumber could look up anything he wanted to know. Perhaps the current emphasis on "reading-to-learn" in the curricular setting should be modified to the prevalent "reading-to-do with incidental learning" of occupational reading. Granted, some knowledge is essential; but the current standard of what is essential for plumbers to know is the certification exam, not practical applicability. To this end, students also spent considerable time practicing and memorizing potential exam questions. It appeared that the certification interests were being served, rather than the curricular and/or occupational interests of the trade.

From the point of view of the training situation, changes could be made to improve the preparation tradespeople receive to handle the reading demands of each job component. Perhaps, as Jacob, Crandall and Scribner (1979) suggested, a job-related literacy program should be designed from an understanding of the documents used and the literacy tasks actually encountered on the job. Perhaps the curricular reading demands should be altered to more closely resemble occupational reading demands; Sticht (1978) noted that the transition from student to incumbent requires a shift in the type of reading normally engaged in, and that this would not present a problem if the stategies used for the two types were the same. Perhaps functional reading instruction should be instituted to assist the students with vocational reading materials; Horne (1979) recommended short term support geared to immediate and specific literacy demands. Perhaps the vocational materials are at too difficult a readability level and should be made more "readable". In summation, from the results of this study, there are implications both for the role and treatment of reading in the curricular component of the plumbing vocation, and, more importantly, for the general attitude towards reading as a vocational skill in the plumbing trade.

SUGGESTIONS FOR FURTHER RESEARCH

From the procedures and observations of this study, there are suggestions for further research in at least four areas.

First, the area of readability assessment remains as controversial as ever. The "unaided recall" procedure employed in this study may be used to give an indication of the (mis)match between reader ability and material difficulty although it has severe limitations, as do all other assessment procedures. Research is needed to make the unaided recall procedure more reliable and quantifiable. As well, as there are currently no acceptable assessment methods for other than connected discourse, perhaps the unaided recall procedure should be tried on graphs, tables, forms, blueprints, memos, examination questions, and other reading tasks. As well, the issue of graphical literacy was not addressed separately in this study; however, research is needed to determine how and to what extent the reading of charts, graphs and tables is related to "reading". In most cases, it appears to considered a mathematical skill when perhaps it should more appropriately be treated as a reading skill.

Second, in the delimitations of this study, it was noted that this was not an attempt to determine the level of functional and occupational literacy demanded by the plumbing trade, as literacy involves more than reading. Basic communication and computation skills are often tied together and perhaps should be treated as a whole. Therefore, research into the entire range of literacy skills involved would be valuable to the development of curriculum and instruction in vocational education.

Third, the code books are vital to the plumbing vocation, and a primary purpose of the educational component of the trade appears to be to interpret the code book for/to apprentices. Since research in the field of content area reading has provided methodologies for functional reading instruction, perhaps research should be conducted in applying such methodologies as reading guides, structured overviews, and directed learning activities to the trade manuals in particular and to vocational reading materials in general. As well, it is conceivable that, through research, the code books could be made less difficult to read.

In summation, further research is needed to emphasize the importance of reading as a vocational skill, and to give direction to curriculum development and instruction in trades education.

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APPENDIX A

ATTITUDE QUESTIONAIRE AND SUBJECT RESPONSE

Appendix A:1: Attitude Questionaire

Instructions: Please circle your answer or fill the blank.

1. In my job, reading is:

   very important   sort of important   not important

2. With the reading I have to do on the job, I am:

   very comfortable   sort of comfortable   very uncomfortable

3. As a reader, I consider myself to be:

   above average   average   below average

4. I read for personal enjoyment and relaxation:

   often   sometimes   never

5. Outside of working hours, I read job related literature:

   often   sometimes   never

6. On the job, if I wanted to know something and I knew it was in a book, I would:

   look it up   ask somebody else   forget it   ____________

7. During a usual day, I spend about _______ minutes reading for my job.

8. Problems with reading could hold me back from promotion:

   YES   NO

9. I would like help with some of the specialized reading I have to do.

   YES   NO

10. I could do my job well without reading at all.

   YES   NO

Appendix A:2: Time spent reading

STUDENTS		INCUMBENTS	
Subject	Time/minutes	Subject	Time/minutes
1.	60	6.	60
2.	60	7.	10
3.	120	8.	10
4.	120	9.	15
5.	960	10.	30
mean	168	mean	25

Appendix A:3: Student response to Attitude Questionaire

1. In my job, reading is:

   very important (5)   sort of important   not important

2. With the reading I have to do on the job, I am:

   very comfortable (2) sort of comfortable (3) very uncomfortable

3. As a reader, I consider myself to be:

   above average (1)   average (3)   below average (1)

4. I read for personal enjoyment and relaxation:

   often (3)   sometimes (2)   never

5. Outside of working hours, I read job-related literature:

   often (1)   sometimes (4)   never

6. On the job, if I wanted to know something and I knew it was in a book, I would:

   look it up (5) ask somebody else forget it ____________

7. During a usual day, I spend about ______ minutes reading for my job.

8. Problems with reading could hold me back from promotion:

   YES (2)   NO (3)

9. I would like help with some of the specialized reading I have to do:

   YES (3)   NO (2)

10. I could do my job well without reading at all:

    YES   NO (5)

Appendix A:4: Incumbent responses to Attitude Questionaire

1. In my job, reading is:

   very important (5)   sort of important   not important

2. With the reading that I have to do on the job, I am: very comfortable

   (2) sort of comfortable (3) very uncomfortable

3. As a reader, I consider myself to be:

   above average   average (5)   below average

4. I read for personal enjoyment and relaxation:

   often (1)   sometimes (4)   never

5. Outside of working hours, I read job-related literature:

   often (1)   sometimes (4)   never

6. On the job, if I wanted to know something and I knew it was in a book, I would:

   look it up (4) ask somebody else (1) forget it ___________

7. During a usual day, I spend about _____ minutes reading for my job.

8. Problems with reading could hold me back from promotion:

   YES (1)   NO (4)

9. I would like help with some of the specialized reading I have to do:

   YES (3)   NO (2)

10. I could do my job well without reading at all:

    YES   NO (5)

APPENDIX B

TASK CHECKSHEET
AND
RATING CATEGORIES

Appendix B:1
TASK CHECKSHEET

TASKS	Variety	Complexity	Frequency	Perceived Importance	General Strategy	Specific Strategy
work orders						
purchase orders						
invoices						
claims						
application forms						
schedules						
blueprints						
maps						
telephone directories						
dictionary						
catalogues						
textbook						
letters						
memos						
trade manuals						
company regulations						
contracts						
trade magazines						
examination questions						
safety & medical warnings						
material installation procedures						
tool & equipment directions						
work/study procedures						
other (specify)						

Appendix B:2 Rating Categories For Task Checksheet

Complexity:

1. entire book
2. part of a book/text
3. part of a book/chart
4. 1-3 page text
5. 1-3 page chart
6. other

Frequency:

1. less than once a month
2. once a week to once a month
3. 2-4 times per day
4. daily
5. never

Perceived Importance:

1. not important
2. important but not vital
3. vital to the completion of a task

General Strategies and Specific Strategies

1. reading-to-learn

   a. reread/rehearse
   b. problem solve/question
   c. relate/associate
   d. focus attention/concentrate

2. reading-to-do with no learning

   e. fact-finding in text
   f. fact-finding in charts, graphs, maps, tables, etc
   g. following directions using text
   h. following directions using charts, etc.

3. reading-to-do with incidental learning

   i. special learning strategy (1. a.-d. above)
   j. repetition of reading task over days or months
   k. single-trial learning: application of information'fixed'it
   l. other (specify)

4. reading-to-assess

   m. usefulness for a particular task
   n. whether to read more carefully later
   o. whether to pass material on to someone else
   p. other (specify)

Appendix B:3 Categories for Strategies

1. Reading-to-learn tasks (in which the individual applies strategies designed to ensure retention of material read).

   a. Reread/Rehearse (involves repeating the processing of information taken from the text, with minimal elaboration or transformation)

   b. Problem solve/Question (involves answering text questions, solving problems in text)

   c. Relate/Associate (involves the use of mnemonics; discussion of material; associations of new information with other information; elaboration)

   d. Focus Attention (involves activities which reduce the amount of information in some manner, eg. underlining, outlining, making notes, etc.)

2. Reading-to-do tasks with no incidental learning (involves using material as a reference or "exterior memory" for completing a task).

   e. Fact-finding in text

   f. Fact-finding using charts, graphs tables, etc.

   g. Following directions using text

   h. Following directions using charts, graphs tables, etc.

3. Reading-to-do tasks with incidental learning (involves using material reference to complete a task, but learning the material in the process so that the material ceases to function as "external memory").

   i. Use of a special study strategy (like ones mentioned in #1. above: reread/rehearse, problem solve/question, relate/associate, focus attention)

   j. Repetition of reading tasks over days or months caused learning to occur (several trial learnings)

   k. Application of the reading information to a job task once caused learning to occur (single trial learning; eg. a worker reads directions, does the task, and henceforth remembers how to do the task without referring back to the directions)

   l. Other (specify)

4. Reading-to-assess tasks (involves strategies aimed at quickly going through material in order to reach decisions about its use).

   m. Assessing usefulness for a particular task

   n. Assessing whether to read the material more carefully (or to use the material later to complete a task, etc.)

   o. Assessing whether to pass the materials on to someone else

   p. Other (specify)

APPENDIX C

RECORD OF OBSERVATION

OF SUBJECTS

APPENDIX C:1

Record of Observation
of Incumbents

Appendix C:1 Observation of incumbents

Observation: 8:00-12:05 Jan. 5, 1983
Carl: service and maintenance

8:00 cursory glance at job instruction memo with simultaneous verbalization by boss

8:20 scanning of "rating plate" on furnace to find serial numbers to select correct replacement part

8:40 scanning parts packages for correct number and size of thermocoupler

10:30 check phone book for address to mail bill

10:30-10:35 write out work order; reread for accuracy and completeness

10:35 check notebook for part to order for furnace

10:50 scan work order; comparison to job instruction

10:52 refer to notes to place phone order of parts

10:55 fill time card re: job completed

11:05 scan switch plate on boiler for make and model numbers

11:10 scan two new gas valves to compare numbers to ensure that the new one is correct

11:50 scan rating plate on boiler for numbers

11:55 check new part's box for correct number

12:05 compare work order to job actually done

Note: unless otherwise indicated, all incidents of "reading" were less than one minute in duration

Observation: 8:30-12:30 Jan. 6, 1983
Les: commercial plumbing
(working on a new school)

9:25 scan blueprint for vent size

9:40- flip through blueprint book for correct page/chart,
9:43 scan blueprint for room height

10:40 check blueprint for placement of a valve

Note: unless otherwise indicated, all incidents of "reading" were less than one minute in duration

Les chatted constantly as he cleaned pipe joints with his hands and spot welded joints. He noted that he was always learning new things. As well, at the beginning of a new job, he had to constantly refer to the blueprints; however, he tried to remember what he had read to cut down on the number of times he had to check in the future. That was the reason he had to refer so seldom to the blueprints. Finally, at the beginning of a new job, he had to spend a great deal of time with the "spec books" and "shop drawings" in order to anticipate problems, to peruse the materials used, and to plan ahead.

Observation: 8:00-12:00, Jan. 7
Wayne: owner/operator

8:00- scan "service book" for day's schedule for worker (name, date
8:05 and problem for maintenance/service)

8:20- scan work order/invoice for completeness and accuracy; scan
8:23 price list in catalogue to complete invoice

8:30- repeat above
8:32

8:45 scan a customer's memo/list for a part needed

8:50- scan invoice for part's number; scan catalogue for number of part;
8:55 transfer new number to order book with customer's name; scan catalogue for part's name and description (found on three pages of charts and diagrams)

8:55 scan personal phone directory cards for number to order part

9:00 check catalogue for a second number while on the phone

9:10- flip through/scan two catalogues for the description and price of a
9:15 part for a customer

9:15 scan directory cards for a phone number

9:16 check a customer's invoice to confirm order and availability (while on the phone to customer)

9:20- check materials list for those needed for a new job
9:25

9:25- scan/flip pages in two catalogues for diagrams and names of
9:30 materials with prices

9:30 scan a cheque for completeness/accuracy

10:35 scan rating plate on a furnace for BTU and size

10:55- opening mail; skimming: bills for totals and relevance, cheques
11:00 for sender and total, brochure for update on banking procedure, advertising for relevance, trade association memo for meeting announcement

11:10- scan invoices for numbers and totals to punch into cash register
11:12

11:40- scan catalogue for materials for a customer (over the counter) re:
11:42 price and description of a part

11:45 scan label on part's box for number

Observation: 8:00-12:00 Jan. 11
Tak: service and maintenance

9:30 scan rating plate on a furnace for make and model numbers

9:50 peruse installation diagram for placement and size of furnace filter

11:20 skim installation code book for section on air vent size

Observation: 8:30-12:30 Jan. 13
Andy: residential

Andy didn't do any reading. His day's instructions were given to him verbally, and he spent his morning in ditches behind new houses (2) shovelling and fitting pipes together.

APPENDIX C:2

Record of Observation of Students

Observation: 8:00-11:45 and 1:00-2:45 Jan. 19
Fourth year plumbing apprentices

8:00- almost entirely verbal interaction: intermittent reading of code
book in response to handout questions from previous class;
reference to "Table J" during question/answer period; procedure:
largely read question in handout (one sentence question with
diagram) and discuss the answer with reference to the code book
(instructor expected students to have worked out the answers);
reference to the specificity of wording on exam questions (eg.
"more then 15" - not "16")

9:05- continuation of class discussion
9:10

9:10- written quiz
9:40

10:05- reference to notes, previously read, re: labelling of diagram
10:14 parts, reading of a graph/table on the exam

10:16 same as above

10:30 reference to notes on venting during lecture

10:43 same as above

11:05- lecture/demonstration re: use of correct table (from code book)
11:45 for given situations: students read overhead projection of chart/
table to compute the correct chimney/vent sizes

1:00- correcting morning's quiz: instructor read question and correct
1:45 answer, students followed along; sometimes a brief discussion;
emphasis given to wording of questions

2:05- class worked on "blueprint drawing" exercise; involved reading and
2:45 drawing basic blueprint diagrams

APPENDIX D

ASSESSMENT OF READING DIFFICULTY OF REPRESENTATIVE MATERIALS: READER/MATERIAL MATCH ASSESSMENT

APPENDIX D:1

Reading Selections From
Representative Materials

SUBSURFACE DISPOSAL FIELDS

(a) Purification in the Disposal Field:

Septic tank effluent contains minute particles of sewage, or suspended solids, and intestinal and pathogenic bacteria. When the effluent is percolated into the ground, these impurities are attacked by myriad biological organisms naturally present in the soil. These organisms utilize the organic materials as food and thus oxidize them into safe and stable compounds. Thus, the "secret" of the purification of sewage effluent in the soil is actually a vital stage in the "nitrogen cycle" in which the complex organic proteins are broken down into simple and stable inorganic compounds.

The biological organisms which perform this miracle are "aerobic", i.e. they require the presence of available oxygen for life. Their natural habitat, therefore, is the surface and upper layers of the soil. This explains why lighter soils and comparatively shallow disposal fields are the most efficient for effluent disposal, and conversely, why weeping tile laid 3 feet or more below the surface is not satisfactory.

It also explains the reason for the intermittent flushing of fields, the rest period required between flushes, the air space in laterals, the use of light soil for back-filling of trenches, the use of more tile than is necessary to hold the effluent, etc.

If a portion of a disposal system is permitted to become constantly saturated, the oxygen is driven out of the soil, the aerobic organisms die, the soil becomes sour and septic. The process of oxidizing the suspended solids and the pathogenic bacteria ceases, and a danger to health exists. The suspended solids accumulate rapidly and the interstices of the soil become plugged. The rate of percolation into the soil decreases until the whole disposal system becomes inoperative.

For this reason, longer rest periods are provided between flushes into heavier soils. If the rest period is insufficient to permit proper aeration of the soil, the system will become clogged much sooner. If adequate aeration of the field and soil is possible, the tile will be found virtually free of deposit even after many years.

(b) Depth of Laterals:

In order to be shallow enough to be in the presence of the necessary aerobic organisms, weeping tile laterals in Alberta should be laid at a depth between 12 in. and 24 in. In very porous soils (gravel) this depth can be increased to about 30 in. if the prior approval of the Inspector is obtained. Installation of a lateral is shown in Fig. 5.

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TABLE D

Size of Trap in mm (inches)	Hydraulic Load Fixture Units
30 (1 1/4) or less	1
40 (1 1/2)	2
50 (2)	3
65 (2 1/2)	4
80 (3)	5
100 (4)	6
Column 1	Column 2

(3) Except as provided in subsection (4), the hydraulic load from a fixture that produces a continuous or semi-continuous flow, is one fixture unit for each 0.04 litres per sec. (1/2 gallon per minute) of flow.

(4) Where a fixture that produces a continuous or semi-continuous flow drains to a combined drain or sewer, or to a storm drain or sewer, the hydraulic load from the fixture is 0.03 litres per sec for each square metre (28 sq. ft. for each gallon per min.) of flow. (AR 340/77; 295/80)

116. (1) The hydraulic load from a road or paved surface shall be determined by

(a) the area in square metres (square feet) of the horizontal projection of the surface that is drained, and

(b) one-half the area in square metres (square feet) of the largest adjacent vertical surface.

(2) Where the hydraulic load is to be expressed in square metres (square feet), fixture units shall be converted so that

(a) when the number of fixture units is 256 or fewer, the load is 83 m^2 dS(1000 sq. feet), and

(b) when the number of fixture units exceeds 256, the load is 0.36 m^2 (3.9 sq. feet) for each fixture unit. (AR 340/77)

117. (1) The hydraulic load that is drained through every soil or waste stack shall be sized as specified in Table E. (AR 340/77; 295/80)

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PRESSURE TANKS

Ron Johnston, Water and Sewage Engineer
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Engineering Field Services Branch

A pressure tank is required in a farm water system to maintain pressure in the system when the pump is not in operation. The amount of water which can be taken from the system between pump cycles is called "draw off".

Galvanized Pressure Tanks

A common type is the standard galvanized pressure tank. It relies on a cushion of compressed air to deliver the water to the distribution system while the pump is not in operation. Water under pressure has a high capacity for absorption of air and gases. In a standard galvanized pressure tank the water and air are in direct contact so the air is rapidly absorbed. The pressure tank becomes "water logged" when it contains insufficient air; in this situation the pump will go on and off more often than necessary. Therefore, some method of regulating the air volume in the pressure tank must be used. Air volume controls balance the air-water ratio in the tank by adding or releasing air, depending on the requirements of the pressure system. If there is too much air in the pressure tank, due to gases in the water or a piston pump which automatically adds air with every pump stroke, a deep well automatic air control is required. This control is float-operated and releases the excess air or gas. Automatic jet chargers perform the opposite function – they add air to the tank through a venturi assembly. Diaphragm type controls add a small charge of air each time the pump stops, but only if air is needed. Both the above controls can be used on shallow or deep well jet pumps.

Precharged Pressure Tank

Recently the lined pressure tank containing a rigid float has become more popular (fig. 1). The rigid float covers the water surface and separates it from the air, thus slowing down the rate of air absorption. Precharged with the recommended amount of air, these tanks will have up to double the draw off of a standard galvanized tank. This type of tank must be recharged with air about once a year to prevent "water logging". Rubber floats that can be rolled up and inserted through the 1 1/4 inch pipe tapping in a standard galvanized pressure tank, thus converting it to a float type of tank are available.

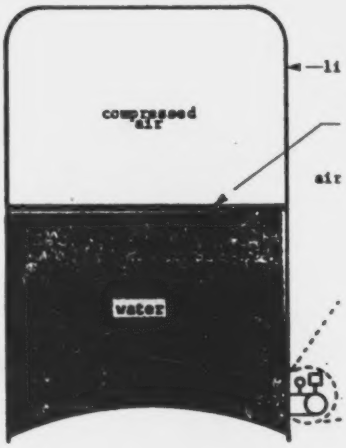

Figure 1 PRECHARGED FLOAT TYPE PR

The procedure for prec
setting the tank discharge cont
1) Shut off pressure pump.
2) Drain all water from th
the pressure tank discha
3) Using a compressor or a
to 3 – 5 psi below the pı
4) Start the pump.
5) Open several household
6) Slowly open the press
valve.
7) When the pump starts, s
the pressure in the tar
pump cut-in pressure w
This will ensure that wa
the tank faster than it c
precharge air cannot escı

Sealed Diaphragm Pressure Ta

The latest type of prech
glass or metal and contains
diaphragm (fig. 3). This cell i
absolutely no air-water contac
be recharged.

APPENDIX D:2

Major and Minor Points in Reading Selections

Selection A: Subsurface Disposal Fields

Major points

1. When the effluent is percolated into the soil, the impurities are attacked by myriad biological organisms.
2. These organisms are called "aerobic".
3. They require the presence of oxygen for life.
4. They live in the upper layers of the soil.
5. This is why lighter soils and shallow fields are more effective.
6. Weeping tile below a 30 inch level are not recommended.

Minor points

a. Septic tanks contain sewage and bacteria.

b. Aerobic organisms "eat" organic materials and oxidize them into safe compounds.

c. This process is part of the nitrogen cycle.

d. This process explains the reason for the intermittent flushing of fields, the rest period between flushes, the air space in laterals, the use of light soil for back-filling trenches, the use of more tile than is necessary, etc.

e. Soil becomes septic if it is saturated, and a danger to health exists.

f. In heavier soils, longer rest periods are provided between flushes; with proper aeration, tile will be free of deposit for years.

Major points

1. Except as provided in subsection (4), the hydraulic load from a fixture that procedes a continuous or semi-continuous flow, is one fixture unit for each 0.04 litres per second (1/2 gallon per minute) of flow.

2. Where a fixture that produces a continuous or semi-continuous flow drains to a combined drain or sewer, or to a storm drain or sewer, the hydraulic load from the fixture is 0.03 litres per second for each square meter (28 sp. ft. for each gallon per minute) of flow.

3. Where the hydraulic load is to be expressed in square meters (square feet), fixture units shall be converted so that when the number of fixture units is 256 or fewer, the load is 93 m^2 dS (1000 sq. feet),

4. and when the number of fixture units exceeds 256, the load is 0.36 m^2 (3.9 sq. feet) for each fixture unit.

Minor points

a. Hydraulic load is determined by the area of the flat surface and one half the area of the largest vertical surface (for a road or paved surface).

Selection C: Pressure Tanks

Major points

1. Pressure tanks maintain pressure in the system when the pump is not in operation.
2. Compressed air in direct contract with water is absorbed rapidly, resulting in water logged tanks.
3. When the tank is water logged, the pump will start and stop frequently.
4. Air Volume Control is used to balance the air-water ratio in the tank.
5. Diafram-type controls add air when the pump stops, only as required.

Minor points

a. "Draw off" is the amount of water which can be taken from the system between pump cycles.

b. A common type of pressure tank is the standard galvanized pressure tank.

c. A cushion of compressed air delivers water to the system.

d. Water under pressure has a high capacity for absorption of air and gases.

e. Air volume controls balance the air/water ratio by adding or releasing air.

f. A deep will automatic air control is required if there is too much air in the tank due to gases in the water or an automatic piston pump.

g. This air control is float-operated.

h. Automatic jet chargers add air through a venturi assembly.

i. Both types of controls can be used on deep or shallow well jet pumps.

APPENDIX D:3

Reader/Material Match Assessment Procedure

1. Directions stated by researcher: "I'm trying to determine the difficulty of some of the materials you use. The purpose is not to measure your ability, but to determine the reading difficulty of the material."

2. One of three reading selections handed to the subject (selections were lettered A, B, and C, and were given to subjects in rotating order, ie. A, B, C to the first subject, B, C, A to the second, and so on).

3. Directions stated by researcher: "Read this first passage and when you're finished, I'm going to ask you to explain to me what it says. Take as much time as you need. Are there any questions?"

4. Selection read silently by subject.

5. Directions stated by researcher: "Now, explain to me what it says." (Tape recorder started).

6. Subject 'explained' what had been read (then tape recorder stopped).

7. Steps 4, 5 and 6 repeated for each of the other two reading selections.

APPENDIX D:4

Transcripts of Verbalizations

Gord

Explain to me what it says. OK, it's talking about a pressure tank...uh...The design of the pressure tank is to keep pressure in the system when the pump isn't working. Now uh...OK, the water OK, there, there's water and air in the pressure tank. Air in in the top part, which uh keeps it pressurized because, uh water itself cannot be compressed. Air has to, it has to have air in it to it to always have pressure. Y'know the air in the tank can be...dissolved because it's in direct contact with the water, and there's different devices which, uh keep or regulate the amount of air in the tank. Uh...the one...is a, a piston which on each stroke adds...air to the water. Now, sometimes if there's too much, if it's got too much air in the water, you need uh...I forget the name of it, but, you need a device which will release the...amount of air if it becomes too much, plus also there's...an automatic control that will allow air into it when there's not enough. mmhmm. And basically that's...what I get. OK, when, when do you need a pressure tank? OK...mostly on, on a farm, water where there, where there is no pressure system where you have, say a well, a deep or shallow well. I see - OK now you get a pause.

OK. This was, was it just this section you had trouble understanding? No there were, I probably wrote down uh, as far as a whole section, that was probably the biggest, there were...uh clauses way like 29-1, or, you know. I, I have a sheet that has about, oh, probably a dozen or so mmhmm that I really didn't understand. Having read it now, is is it clearer to you? Uh, I read it over twice...it's, there's still a little bit that I don't understand like, OK it's talking about... the hydraulic load...when you're considering drainage for a determine...the, the hydraulic load, it's the total...area of the horizontal surface plus 1/2 of the vertical surface. mmmm. Now that's what that says, but that's I really don't understand that. Uh...What do you do, what do you use with what you find out?...The numbers you come up with, what's the hydraulic load? OK, that's, that's to size your drain...Oh, the stuff that was on the blackboard last time? ...OK, no, I don't think you were there, I don't think about fixture units or something. OK fixture units, right. Yeah OK yeah, this is talking about fixture units. Uh...they're saying that uh, say for every 1000 square feet...is 256 fixture units. For less than 1000 square feet its 3.9 litres...no it's uh, just a minute...3.9 square meters...now, this I don't really understand, that's why I can't give you a clear...a clear definition of it. OK, so do you think you've pretty well...covered this, as much of this as you understand or is clear to you? Uh...I don't want to cut you off. Well, lemme just...think for a minute more. Uh...(pause) I guess for what I can put in words, that's as clear as I can explain it. OK, thank you.

OK, uh...this is talking about the purification of the effluent which is the liquid waste from a, generally a septic tank it's...what you're usually talking about. Uh...the effluent though it'll, it contains uh, digested particals, you know it isn't strictly water, it has some, uh bacteria in it, and the bacteria which is found in effluent is known as anerobic bacteria, more or less break them down. Uh... that's why it's important to not install the field too low, because if it's installed too low, to low, the aerobic bacteria isn't present there, and it'll cause the field to become...uh sour or septic they call it, and uh...it'll saturate the field, and eventually drive all the organ, the all the aerobic organisms out of the soil, so it won't be able to break it down, and the field will become clogged, and you'll need a new field.

Ken

Now explain to me...OK they're talking about the effluent in the, out of a septic tank, uh, contains orgas uh...uh...all it's microscopic uh material which uh, uh aids the nitrogen cycle, which is an aiding factor in the nitrogen cycle, uh...(pause)...its anerobic uh, uh material, and once out in the laterals of the field, uh the reason for, once it comes in contact with the upper layers of the soil it becomes aerobic because of the oxygen in the, in the material, and if your field has a tendency to become saturated for too long a period of time, no resting period, then you have a tendency for these aerobic, bic, to die which, do not purify your, keep your soil fairly purified, and thus it become...dead and uh, basically what it says there. OK, what, what is the purpose of, you know, the (unintelligible) field? Who might need to know this? Well, so that if you're uh sizing your field and your septic tank, if you size a system which is too small for the, your septic tank, like say if you design for a five bedroom house something and you only put the minimum size septic tank and, and its, and it turns out to be too saml1, you have too much flushing into your field, too frequently a flushing, and it becomes uh, doesn't get that rest period to dry out, and everything else, and to after the field becomes saturated, uh your aerobic organisms uh, organisms die and then you become inoperative, it doesn't do it's job. You know, I'm starting to understand this (laughs)...slowly ...OK you can turn that off for a sec if you don't mind.

First you're talking about the hydraulic load of uh, a fixture, how it's determined, and its uh 6 1/4 gallons per minute, and then they've got it down to the metric which nobody works on. And uh, when, then there's sizing, uh, the total surface area to be drained uh, they go by fixture unit loads of uh, roof area, and it's 256 fixture units for uh, 1000 square feet, and if it's over 256, it's 3.9 feet for every uh, fixture unit after that. That's basically it. You've got it. (unintelligible) It talks about converting it into square meters like you said, but nobody uses that. No, I mean I...You think they will in the future? Are you being pressured by this...metrification of Canada? Not on the job. No? Not that much, I mean you have your prints are in, some of it is getting into metric eh? Uh, all your government's jobs, that goes for hospitals, that was in metric. But uh, your pipe size is still in Imperial. That explains the next question, and tools too, aren't they? mmhmm. Still Imperial. So you, you're converting kind of back and forth, they say that you're not supposed to, but how else you gonna do it? That's right, it's neither one or the other anymore. mmhmm.

And here's the last one. K, first of all they're talking about uh, the reason for putting in a well we call it a storage tank on a pressure system so that the pump is not cutting, cutting in and out. The di, the different tem, the different uh, differential between uh, uh, pump cutting out. I mean before it cuts in, back in again is called your drawdown, and uh, on a galvanized tank with, it lies on a cushion of air to uh...maintain the drawdown, is what it boils down to, and if your galvanized tank becomes too full of water, becomes airlogged then you, your system has a tendency for your pump to cut in and out quite frequently. Uh, the reason you're getting uh, uh air into your system is cause when water is under pressure, it has a tendency to accummulate air, and uh, Does it get too much? Yeah, tendency is to create kind of a air...air situation into the water instead of maintaining on top to act as a cushion, eh? Uh, they're having a couple of ways of uh, remedying your situation if you have a tendency for uh...to gettin, you got a say, gas in your, from a deep well, you have a tendency of having air coming int, from you water, from your well, then you have to, uh, put in a, uh air volume control which will uh, eliminate the air. And uh, on a, say a shallow well when you're uh, when you require the air, when you need the air, then you have a air volume control which maintains you air. mmmm. That's basically what I can read out of it anyway. What's a venturi assembly?...Well it, it governs your uh, your principle of your pump system, it's the whole process of centrifical pumping. Water is, uh pressurized through the venturi tube to create your pressure. Oh. That's basically it. I just saw the word there, and I thought what does that mean? (laughs) (unintelligible). It works on a, have you ever noticed, have you ever seen a, on your flame it's got a, usually a big dial, maybe the size of a...oh 2 inch piece of pipe or something and then, throats down and then it shoots out into your burner eh, and that little tube in there is called your venturi. Oh. It's on the same... I'll be looking for it tonight (both laugh) Thanks Ken. OK. Appreciate that.

Kelly

OK what they're basically explaining in that portion of the code is uh...how, how to calculate uh, size of the drain that you're gonna need to uh, drain uh, either a roof or a, or a paved section. And they calculate it by figuring out first of all how many fixture units, which is a measurement of how many, the the flow of uh liquid in a pipe. First they convert, and I think it's 3.9 feet, over er square feet fer, is one fixture unit. Uh, anything over...would...let's see, I'm getting lost here. OK (laughs) Just relax. When you're calculating, you use the uh, area of the roof, and if it's 1000 square feet, that's uh, 256 fixture units I believe. And anything over that mmhmm is calculated at 3.9 feet, er square feet per 1 cubic, er per 1 fixture unit. So, what basically that's describing is how to size a, an, a area drain for a roof or a paved area, like a driveway or something like that. And that's it? Yeah, basically...That's your numbers, eh? Yeah, there's Isn't it tough to remember all these numbers? Well, the thing For your exams do you have to memorize those the main thing to remember is that 256 fixture units is 1000 square feet, and anything over that is 3.9 square feet for 1 fixture unit. mmhmm So once you know that, if you know your table, which is the table above the information there mmhmm, I believe, then you can, get your sizes from that. You see them, they don't expect you to remember yer...too, too many of your tables I think you we have to remember 4 different tables which isn't serious, but the one on, uh, drains, area drains and stuff like that, we don't have to remember. mmmm

The lead table with the calculation. Oh this, makes it easier eh? Yeah. OK do you want to turn that off and we'll do this one.

K, in that particular piece of notes, they're, they're describing the function of a automatic air control, uh, which senses how much air pressure is inside...uh a tank. OK on a, on a pressure system, you've got a dis, the tank, the galvanized tank, and if it was full of water, uh you wouldn't have any pressure, because you cannot compress water. You can compress air to produce pressure, but you can't compress water so, what, what that does is, uh, it allows air into the tank, the pump cuts in when the pressure drops. Somebody opens the tap, the pressure drops. The air pressure drops because it's forced water out of the tank. Water comes in, and the pump builds up the air pressure, pressurizing the tank and getting it back to the required pressure, whatever pressure you want it set at. If you want 40 pounds, the pump will pump it up to 40 pounds, then cut out. Then you've got an air gap inside the tank which is creating the pressure, that makes pressure is, is... Automatically Automatically, yeah, soon as the pressure drops, the sensing device, senses that the air pressure has dropped uh they usually work off of bellow, bellows or something like, that, a diaphram. That's what that one is about, I would say. What's a venturi assembly? A venturi assembly, uh ahem. I think you'd best describe that by, uh, the venturi action is by water flowing past an opening, or air flowing past an opening. It has a suction and a drawing effect which will pull, so in this instance, as water is being pushed in, it's also sucking air into that line, there's air and water. Ahh. There's air and water, and it's just, that's where or, if it's not being directly pumped up, the venturi action would be...created by the water flowing into the tank. It would draw the wa, the air, required air for the, or vice-versa. mmmmm from the air being pumped in, it would suck the water in. It's just that basically one uh, air or liquid moving in one direction if you've got an opening on the side, it will draw from that line to basically, it's venturi action. OK - not that it's in here, it's just that I was interested.

OK, basically that one describes the operation of uh, a septic tank or what, how basically how they work, uh, when they break down the sewage effluent, into inorgon, inorganic compounds. Uh, it's...called a nitrogen cycle, or something like that. anyway uh, what happens is your septic tank will flush effluent sewage which is the clear, or the, the liquid waste out into a field, and because...the reason that a field is only 2 to fff, uh 12 to 24 inches below the surface, is because in the top 2 feet of soil, uh, there are aerobic bacteria which will break down the un...the sewage effluent into inorganic compounds. But, uh...it's not just entirely the aerobic bacteria, like it says a little later in that, it's the uh, the fact that there's already bacteria in the effluent when it gets flushed out and spread out, and exposed to air, it just basically dissolves into the soil. And, therefore, not purific, it says purification, but uh, sewage is never pure. There's absolutely impossible to purify. Sewage, all that does is it breaks it down so it's not...you know like they, nobody's ever going to be exposed to it, couple feet underground. mmhmm. Where and what happens if it will if the systen isn't working right? OK, well if you got either not enough anerobic bacteria, or if your field is buried too low and it's not getting enough aerobic bacteria from the surface, and from the surface, and from the surrounding ground, what'll happen is uh, the field will be slowly plug up, but the main cause of plugging or blockage in a field, isn't, the fact there's...lack of aerobic bacteria because, no inspector will let you put one in anything, any deeper than 2 feet. Yeah. but uh, usually what it is is that, the tank isn't clean, and it passes undigested solids out into the field. mmmmm. And it's not just the effluent which is the liquid, the solids stay, the liquid goes out. What happens to the solids, anyways? They break down. Anerobic bacteria which is in everybody's body, uh just grow inside the tank just like they would inside your body where it's warm, wet, dark. And it just basically breaks down into...just sludge. And becomes part of the liquid that eventually. Well some of it becomes part of the liquid. It breaks down into really minute particals which can be broken up by, or broken down into inorganic compounds by the aerobic bacteria in the field. But the majority of it settles to the bottom of the tank, and the capacity of the storage tank is so that you wouldn't have to clean the sludge out, anymore than every couple three years uh. But people do end up cleaning out septic tanks. Oh yeah, yeah. You have to And if you didn't, it would just stop working wouldn't it? Well in the end, if you didn't, if you never cleaned it I'd say, what would happen was, it would keep pumping out the effluent as long as it could, and then the sludge level would slowly rise until it got to the, the bell siphon, which separates the two cham, like there's two chambers to the septic tank. One...is uh, I think it's about 50% of the working volume of the tank, and what happens is, the tank fills up with liquid, and there's a, a S trap between these two chambers, and one these chambers fill up, they're both full, this S trap kicks in, and siphons all the liquid out. but it'll only siphon it down to, oh I think 48 inches out of the total I think...minimum, probably be about 5 or 6 feet so there's allowance for about 2 feet of sludge in there before it would ever do any harm. mmmmm But ah, eventually would be that uh, if you didn't clean it is, it would pass undigested solids out into the field. Clog it up and wreck the field Yeah...that's if it didn't clog up the siphon First first which would wreck the whole thing Which would, no you'd just have to get in there and clean it. Hopefully it would plug the siphon before it plugged the field. Yeah But, like there's a lot of draw on that 3 inch...siphon, it pumps 90 gallons per minute wow that's, that's a lot. Yeah so once it gets going, it would probably suck out a lot of...sludge. Anyway, that's basically what that's all about. Thank you Kelly.

Harvey

Explain to me what is says. OK uh, it's to uh, supply pressure in the system, and if you don't have enough air, in your tank...uh, your pump's going to come, come on and off frequently...suggests your uh, your air pressure in there...(pause)...that's all I got from it. OK.

OK, disposal field, uh from the septic tank you have uh, effluent which goes into the field...which for purification you have uh, aerobic bacteria in the soil, which purifies the waste so it's safe to uh...safe to have human beings around...and, and if you uh, you don't have any immediate flushing, the solids uh, that do not settle in the tank will come through your field and plug up the field. So how do they make sure that it doesn't plug up? Well they have a la, they, they have a resting period in each septic tank OK to separate the solids from the...from the liquid, and liquid comes out of the tank, as effluent, and it goes into your field, which is lighter soils, which contains air which your aerobic bacteria needs. So how deep can you put them then? hmmmm? How deep can a field be then? 12 to uh, 24 inches or 30 inches approved by an inspector, but it doesn't say that there mmmmmm (laughs) That's all memory work from the course. That's the story...isn't it. OK, one more.

OK, when sizing uh, roof area it's based on uh, fixture units, and if you have...there are your leaders, if you have 256 uh fixture units or more, that covers area of 1000 square feet of roof. So, so then when you've figured all that out, what do you do with it? That's to size your leaders. What's a leader? mmhmm What's a leader? Your rain water leader, pipe that takes the...they're, they're the drainage for your roof, What about? the the pipe that takes the drainage from your roof. What's a hydraulic load? Hydraulic load is, that's the measurement of uh, it's a measure, uh it's a design factor for measurement of the load of water going through, which is equivalent to uh...uh...I don't know, I forget. Yeah...OK, well done.

Wayne

OK if you can explain to me what it says...Explains, uh,....probably, uh, scientifically how, uh, a field works, or how it can become plugged...... The major points? How can it be plugged? Uh, by uh,........(pause)..... better read that again.....(Pause)...says it can become plugged if it's...the field is saturated or, uh, losses oxygen in the soil...Is there anything more to it? Well a bunch of other scientific crap that I don't really have to, you know that.....you want me to use them pathogenic bacteria ceases? and all that...to explain it? Does that pose any problems for you? No. Familiar with those terms? Uh...I would be more familiar with them if I had to write a test on them....Yes...... because I'd study it more than.....OK...but for me to explain...uh...I could explain that to 10 different people and they still wouldn't understand me MMhmm OK so you think you've covered pretty well what that says in the square? Pretty well yeah. OK.

How they determine the way to size a hydraulic load over combined drain and sewer...and also the hydraulic load from, uh, road or paved surfaced...and uh...by...uh...explaining that it explains how you can use this table. Well that's it... related to fixture units. OK, there is no more in there then, like for you that presents any problems? Just that metric stuff and that in stock, but I notice that they've got it in gallons...and that...OK.

OK now tell me How a pressure tank works...they're using the old fashioned one that galvanize...uh...pressure tanks...it has to have so much air in it eh...to prevent your pump from kicking on and off...and it explains uh...water absorbs air...that's about it...they have to use an air volume control on the galvanized pressure tank...every time a pump kicks on it injects...replenishes the air in the tank...otherwise if the tank was completely filled full of water every time you opened the tank your...er tap or something your pump would come on...so it wears your pump out quicker unless you have air in it...I think that answers your question...about all it says in there...I guess.

Carl

OK what have you got here? It's for sizing rain water leaders...and how do you do that? by the size...you take the...it depend on the size of the area...and if there is a vertical wall there, you have to take 1/2 the size of that basically and it exc...in order to size the size of the rain water leaders which is what the water goes into autimally (automatically?) and goes down...There? any flat roof. And how do you size it then? By the size in square feet...of the uh roof. Say you got a flat roof OK? Say you got a 10 foot was mmhmm OK so you take un the size, the total square feet of the flat surface plus 1/2 the size of the vertical surface...then you go to your chart and it tells you...for so many square feet that you have to have this size of pipe. Oh OK. Then it also tells you...uh...how to convert for when you, no that's for a storm sewer now when you go to...uh sanitary sewer which is for waste and stuff, you if you combine the two you have to convert to square feet...into...fixture units. Oh OK. Now there's I think it's 200 for every 1000 sss, up to 1000 square feet is 256 fixture units, and then after that it's in the chart. There's a little table that tells you how much. You know I'm starting to understand this (laughs). It took me a while...I...I mean I'd gone over this I betcha a dozen times each year in school... and I still have to read it to understand what they're saying. Well I guess it's the concept that makes sense...yeah...and I guess and then when you figure this out then you go to the graph. Like it...yeah...if you told me...uh...somebody said well I got...uh...2000 square feet, how big would the rainwater leader be? I have to check the table...yeah, well nobody's going to memorize the table...that's right, yeah...I mean the book is full of them isn't it? yeah...one after...this tells you how to size... rainwater leader, that's all it tells you... but it's, it's for lawyers, in case there's ever...basically, that's what it's for because a human.. being isn't going to read that isn't going to make any sense out of it...(laughs)...you have to, in case now...uh... something happens, not in this particular case, but...uh...in any case where there's a...uh... discrepency and someone tries to sue someone? alright...they go to court? and you can't dispute the way it's wrotten, wrote in the book... but...uh...something goes wrong like...yeah...and if nothing goes wrong then everybody's happy and nobody really cares. That's right...yeah... except the inspectors...ahem. I, when I was down at..uh.

Sorry...OK. It...uh...basically just tells you what you need a pressure tank in, in a water system in, in...uh...on a farm system like where you have a pump, it explains why you need a pressure tank, what it does...it also explains what a volume air control does and what it's for. What is a volume air control? Well, in there, it tells you that...when you pump water into the pressure tank, if you don't have a pressure tank to start with, every time you'd open the tap, the pump will run, and it'll run for as long as you have the tap open. Now that's hard on the pump, so, in the pressure tank, it has a buildup of air in there, which...uh...you can, you can compress air which makes a pressure, but you can't compress water. mmhmm. So, if you all of a sudden the tank is full of water, because the water will absorb the air after a while, it will...uh...it will just keep coming off and on like no pressure tank at all, so the air volume control...maintains a level of air...it puts air into the tank or takes aire out sometimes you uh like a piston pump will uh...put air into a tank automatically because of the way it operates uh...in the jet pumps...there, that air volume control will uh...put air into it, but if it, the water will absorb the air after awhile and then the tank will be water logged, and then the pump will cut off and on...that's why you have a...so it's to save the pump? yeah, to save the pump, yeah...and the pump is inside the tank? Oh, no, the pump sits outside the tank and pumps, pumps the water into the tank...you're going to have to go through the tank or just use that as a...as a, uh... it's half full of air, usually, if it's working properly, and then there's a storage of water there see when you turn the tap on, that pressure just pushes the water out. So you don't, it's only for forms, it's the only way you have an independent water system? Yeah...uh...how's, uh, how's it work here in town? Well, it's some, some smaller towns will have big tanks...that just work off of gravity like the town oh yeah water is stored above the...above, so high above the ground and that...sss that acts as just pushes it, yeah, that pushes...or they'll have a big uh...I'm not sure, like I know the town here, they have their, their big pumps and that, but uh...I don't know whether they have uh...any...large air tanks or not like that on it. Hmm...makes sense...thank you.

Basically tells uh how uh a spetic field work. Now it tells you that... the sewage effluent when it's pumped out into the field is uh... biologically...destroyed it, it just uh decays and goes and uh... oxydizes so to speak by bacteria called aerobic...now, these, that little bacteria have to have oxygen to live, now they're in the top, say about 3 feet, no not much deeper than 3 feet, so uh...basically that's what it tells you that they do and if you uh, go deeper than say 3 feet with your field, there's no, the aerobic uh bacteria can't live down there so therefore it just uh...saturates uh...it'll just saturate your field. and uh it will clog up after a very short period of time. Now... also if you have your field at the right depth, and your puttin' too much...liquid in there...for the uh bacteria to handle...then it also becomes clogged because...they can't get any oxygen so you have to have a longer rest period between the flushes. What's a flush? The flush from the septic tank which it doesn't explain in there, but your septic tank has two compartments...it uh holds...uh...say 400 gallons and then it slowly trickles into the other compartment every time water comes into the tank, but it's, it's not uh, stuff comin' right out of the house, it's stuff that's been in there for awhile and is, it's off the top like it's just a straight liquid, mmhmm, and uh...it goes into the other compartment and when it builds up...it's on a siphon...type chamber, and when it builds up to say 75-80 gallons, it'll just pump that whole 80 gallons out in a mater of minutes...oh, into the field. Now it depend on how much it's being used, how big the tank is, how big the flush..uh chamber is...uh determines how often...you get...the...the effluent flushed into your field...and if it's too much, like if your field's too small, then it will become septic. If the field is too big, you stand a chance of freezin' up, cause you're not gettin enough into it. That's really tricky...Now, I didn't uh, if I'd have read that for the first time, I probably wouldn't have been able to explain it like that, but I happen to know what they're talkin' about. Yeah, I'm getting that impression, that, this just triggers what you already know...yeah...um... in in part it makes sense doesn't it? Just, just logically... mmmhmmm yeah...But you've studied it...yeah I studied...at least...and I, I know ...once...that this is what it does so..I can tell you pretty well what that's saying, yeah but not because I read it. That's a really interesting point. Cause some people can read that and oh yeah, right now uh some people can read that six times and still not know what it says. mmhmm, well there's some, like pathopathogenic bacteria, doesn't mean anything to me. Doesn't mean anything to me either. (laughs) I uh don't know what pathogenic means. I, I guess this must be the legal talk you talked you know yeah that you mentioned. Say I, I don't believe that is out of the code book 'cause I haven't read anythin quite that in the code book, that's sort of uh...this is out of uh...mmm...now let me think, I should have I've got it written down someplace where I've got this from. It's a uh...mmm...installation manual. Oh yeah, I know the one, yeah it is a type of a codebook, actually. Yeah, It's a government publication, mmhmm, but it's not the codebook, no. Well!!!

Andy

Now, you're going to tell me what it's about. OK it's explaining about pressure tanks on farm systems or places where they don't have a water supply of their own, and they have to have a pressure tank, and uh, a lot of cases where they just have a tank that's pre-charged from the factory, and after awhile the water gets absorbed into the water, and you'll notice on the pump when it's un cycling, it cycles a lot, it goes, duh dut, duh dut, there's a, there's an electric switch, a contact switch, on the uh, on the motor itself, on the pump, mmhmm and it activates by air pressure, and uh...when it, it drop it's I, I, I can't explain the whole thing, I'm fairly new...at working on pressure systems. mmhmm But it it it starts cycling, it goes on and off, on and off, on and off, you could just pour a glass of water, and it would go on and off a couple of times and it shouldn't. You should be able to flush a toilet you know, and it shouldn't go on...because a tank is usually designed to on...so what do they do here? So that they've got a uh uh there they're explaining that to eliminate the problem like that, well in that sort of case you can, they have a a a sniffla valve, it's like a tire valve mmhmm on a tank, and you can pump air back into the tank. But what they're explaining there is that they have an automatic system where if the air goes down in the tank, in other words, the the air in the tank uh, rather than getting absorbed by the water, there's a system there where you can control the amount of air in the tank by the uh, by the...can't read it...where is it? lluh.-.jet chargers...float operated...uh...air volume control. Ok ...I haven't seen one yet (laughs) Laughs OK But uh...well I might have seen it without realizing what it is Yeah But uh...

OK, this is from the uh plumbing code, there's uh, there's a special code for sewage in, for septic systems yeah and it's at the end of the, now it's at the end of the plumbing code. OK, so that, yeah, just hold it up and try...so...it's talking in there about the breakup of the sewage in a septic field by aerobic bacteria which is in the upper layers of the soil. And this is why septic fields are put at, at between 18 and 24 inches in depth. It doesn't say that but I know it's a little further on mmhmm in the code. And uh the...before they put a field in, they do a percolation test, and a percolation test is the, they come around with a diameter of a hole, where the depth is 3 feet, into the ground, and they pour water in there, into the, they pour water in the, they pour water into that hole, until it comes to the surface, and they keep pouring water into it, until, it it it'll go down for quite a while you got to wait until it stops going down, you know, like it slows right down and then you can time it, and you time it, and by timing it you end up with a...a result of so many parts of an inch to the minute, and that, there's that plus the number of, uh, people in the house, and I'm not sure I think it's the number of bedrooms too...sometimes that and the number of, I think it's the number of people and the number of bedrooms yeah, mmhmm, But it's on the gallons per bedroom, uh, about 50 gallons per bedroom mmhmm. And then...they multiply that by there's something else but this will give you the lateral feet, the number of feet for a field. Yeah. And uh, in some cases like in heavier soil...they're talking in sandier soils, uh...you'll notice I've only done a percolation test once, and it's shown how to do it, and it was on sandy soil, and the water just, choooocc, took off, (unintelligible), yeah it took off, and just kept going down and going down, it would have been a good place for a field, yeah and you wouldn't have to have you could get away, uh those were about a 3 bedroom home, 2 or 3 bedroom home, and they could get away with a very minimum field. mmhmm A minimum field, is supposed to be 400 feet and uh, they were talking about a 200 foot field...for that size of house and uh, so they, they're recommending that, you know, that..uh fields be backfilled with a lighter soil if possible. If you, if you've got a heavier field like if you' ve got a heavier soil, yeah, you need a larger field, because percolation takes longer, and uh, they saw in talking about the distance, the, the amount of time between flushes, well that depends on the tank too as uh have a a bell and siphon in the water. The fluid comes up so far and then it just trips itself, and it flushes the field or a pump out, the same thing and, and works on a float..affair that when it comes up and reaches the second float, it triggers the pump and pumps out. That'll only, that'll only happen whenever that, those fill up, but the, the amount of time that the sewage is supposed to stay in the septic tank is 24 hours at least, before it gets flushed to the field that gives the time for the solids to settle out and the, anerobic bacteria uh to work on the solids. Oh I see But uh, they talk about fields getting saturated in there, it's because probably because they're to small. Maybe because they're too deep. What would too deep have to do with it? Well, it's talks in there that the aerobic bacteria thrive and they, and sort of nearer the surface, and uh, and if you go too deep, then you end up with a problem that you just get saturated. OK It doesn't, they it's it's the aer, aerobic, it's the bacteriological uh..working, you know, in the soil cause the, the pipes have holes and the holes come out at an angle mmhmm at the bottom, and the pipes will lay flat in the ground, and when it filters into the, not into the soil there's gravel there's coarse gravel and then there's fine gravel, and then there's gravel up above, just above the pipe, and then they put straw, and then on top of that there's dirt, so the sewage does down into the gravel, and then of course, you know, it's there's air in there and uh...and so it it it sort of works in the soil so, you know, it's uh, a way of getting rid of the uh, sewage in a form or...anywhere it's in town you don't have them, you just get them usually where they don't have a uh, uh, town or a village system. mmhmm, OK, sounds good.

Go Ahead. OK. basically it, it's, it's telling me that when you go to size...uh...drains...and vents this is talking about drains, but drains and vents, they work on what they call and also you can size water lines..too...they talk about fixture units. OK This is talking about drains anyway. And they worked it out that on a pipe, inch and a quarter pipe, and this is sloping, this is now up to 45, well it's sloping, that for every minute, that uh, 28 gallons...28 gallons yeah flows down that pipe, that's one fixture unit. OK, OK OK, now then, obviously for a 4 inch pipe, it'll be more. mmhmm So...on there like, each fixture like, there's a table C in the codebook that's got...each...fixture in there and it's got, how many fixture units each one of them have, like a toilets got 4 mmhmm A flushtank's got...6. In other words, a flushtank with a with just a ball cock in it's got 4, flushtank...with uh uh a flush valve on it mmhmm is 6, and...(unintelligible)...uses 8. A basin like a bathroom's got 1. mmhmm So, and a bathtub's got 1 1/2, but for a bathroom group you've got...6. They, they skip the 1/2 on there they take it as a grouping. So when you go and size up a house, for instance, you want to know what size, what pipes they run. mmhmm Uh, now then, I you're going to be looking up the other codes for this, uh...3 inch, like on a toilet you have to have a 3 inch drain on it, mmhmm although it's only 4 fixture units, if you look in your codebook you could probably run that in...2 inch, I think it is. mmhmm But if you can't, you have to run it at least 3 inch...you see there are, there are, there are other things you can't just read in...in one line and think ah ha this is what I can do and do it that way, because..read through the codebook there's a lot of things that are intertwined together and you gotta read then all to...so when you're sizing so you you work out, you take a house, a basic house that's got...uh, a bathroom, and a kitchen sink, and so that would be, 4 uh, 5 for the bathroom and 1 1/2...for the kitchen sink. And so that's 5 1/2 fixtures, you still gonna have a 3 inch drain...running, out of the house. You know like mmhmm to the sewer. The minimum is 3 inches to the sewer, usually put a 4 inch for a...sewer line, that's between the sewer and the house, and then 3 inch from the house up to the mmm--...and of course you have to have a floor drain that's another...3 fixture units. But they're talking about, they, basically in there they're talking about how they arrive at one fixture unit. Oh And the other part of it is uh... you're working on rain water leaders and you have to work on the size of them, is that they've worked it out on square footage of a roof...and...they have, what is it....under...I'll have to read that again (laughs), but anyway on 256 fixture units, it's 1000 feet. mmhmm There's something about that, and the, over that, over 256 fixture units, for every...fixture...after that you add 3.9 square feet, because there's a code in there that's got how many square feet you're allowed per diameter size. Aaah that's how that works. So, from the 256 fixture units total on a building, you just add 1000 square feet, and if you look in the code you can work out that way what the rain water leaders... (unintelligible)...into the, un if if that's that depends, that's to size up your rain water leader, but also uh, that'll depend too on whether you have a combined storm drain, combined building sewer which means uh, you can run sewage down there and, storm water. mmmmm Sometimes you can have, you like in Lakewood Estates for instance, they have separate storm sewers there. mmhmm And they run to the house, you have a weeping tile running around the footing of the house. You can't run those into the building..uh sewer. You can't, uh, they have to run into the storm sewer and you have to run out, for down there that's that's at the back of the house, and it runs out separately, means running a complete new service. Uh, you know, a complete service out to where the town has their connection. Where I live you can run them into the uh...into the uh right here building sewer. Yeah...well, thank you.

APPENDIX D:5

Recording Sheet for Verbalizations

NAME________________

I. Present (% of total verbalization)

A. text-based major points	A (6)	B (4)	C (5)
1. verbatim			
2. paraphrased (acceptable)			
3. paraphrased (not acceptable)			
B. text-based minor points	A (6)	B (1)	C (9)
1. verbatim			
2. paraphrased (acceptable)			
3. paraphrased (not acceptable)			
C. additions	A	B	C
1. consistent			
2. inconsistent			

II. not present........... % of ...	A	B	C
A. major points			
B. minor points			

Appendix D:6: Points acceptably paraphrased

Article	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
A	52	83	50	83	55	83	38	50 33	38	50	39	33
B	25	0 50	31	50	17	0	29	0	25	0	33	0
C	54	20 60	55	60	53	-	17	22	14	22	22	-

1. mean % of major points acceptably paraphrased by all subjects
2. mode % of major points acceptably paraphrased by all subjects

3. mean % of major points acceptably paraphrased by students
4. mode % of major points acceptably paraphrased by students

5. mean % of major points acceptably paraphrased by incumbents
6. mode % of major points acceptably paraphrased by incumbents

7. mean % of minor points acceptably paraphrased by all subjects
8. mode % of minor points acceptably paraphrased by all subjects

9. mean % of minor points acceptably paraphrased by students
10. mode % of minor points acceptably paraphrased by students

11. mean % of minor points acceptably paraphrased by incumbents
12. mode % of minor points acceptably paraphrased by incumbents

Appendix D:7: Total verbalization broken down

Article	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
A	18.3	31.6	32.7	82.7	23.3	38.8	33.7	95.8	11.6	22.1	31.4	65.1
B	11.8	7.4	15.4	34.6	17.9	4.9	21.6	44.4	3.6	10.8	7.2	21.6
C	36.0	19.1	25.2	80.3	33.2	20.0	25.2	78.4	39.6	18.0	25.3	82.9

1. mean % of total verbalization (major points) for all subjects
2. mean % of total verbalization (minor points) for all subjects
3. mean % of total verbalization (consistent additions) for all subjects
4. total mean % of verbalization (positive = 1+2+3) for all subjects

5. mean % of total verbalization (major points) for students
6. mean % of total verbalization (minor points) for students
7. mean % of total verbalization (consistent additions) for students
8. total mean % of verbalization (positive = 5+6+7) for students

9. mean % of total verbalization (major points) for incumbents
10. mean % of total verbalization (minor points) for incumbents
11. mean % of total verbalization (consistent additions) for incumbents
12. total mean % of verbalization (positive = 9+10+11) for incumbents

Article	13.	14.	15.	16.	17.	18.	19.	20.	21.
A	2.5	15.0	17.5	4.3	0	4.3	0	34.9	34.9
B	25.7	39.6	65.3	23.9	31.7	55.6	28.2	50.2	78.4
C	12.8	6.9	19.7	16.7	4.8	21.5	7.5	9.6	17.1

13. mean % of verbalization (inaccurate paraphrasing) for all subjects
14. mean % of verbalization (inconsistent additions) for all subjects
15. mean % of verbalization (total negative = 13+14) for all subjects

16. mean % of verbalization (inaccurate paraphrasing) for students
17. mean % of verbalization (inconsistent additions) for students
18. mean % of verbalization (total negative = 16+17) for students

19. mean % of verbalization (inaccurate paraphrasing) for incumbents
20. mean % of verbalization (inconsistent additions) for incumbents
21. mean % of verbalization (total negative = 19+20) for incumbents

APPENDIX E

FUNCTIONAL READING INSTRUCTION QUESTIONAIRE AND RESPONSES

APPENDIX E:1

Functional Reading Questionaire

This questionaire is about the apprenticeship courses where you are now a student or instructor. Please circle the best answer for each question, from your experience.

1. How often is the student's reading ability formally tested, with a reading test, at the beginning of a course?

   almost always   often   sometimes   almost never

2. How often are the student's reading problems and study routines discussed informally at the beginning of a course?

   almost always   often   sometimes   almost never

3. How often are step-by-step reading and study routines taught by the instructor before or during a course?

   almost always   often   sometimes   almost never

4. How often is new and review information presented to the students in a lecture, with little or no reading involved?

   almost always   often   sometimes   almost never

5. How often is the same information presented to the students in a lecture/discussion and a reading assignment?

   almost always   often   sometimes   almost never

6. How often is new and review information presented in the form of a reading assignment only?

   almost always   often   sometimes   almost never

7. Before a reading assignment, how often is the student given questions or directions to point out what is going to be important?

   almost always   often   sometimes   almost never

8. Before a reading assignment, how often are there questions or discussion about new words and their definitions?

   almost always   often   sometimes   almost never

9. During a reading assignment, how often is the student given questions, written or verbal, about new words and their definitions?

   almost always   often   sometimes   almost never

10. After a reading assignment, how often is the student given questions, written or verbal, about new words and their definitions?

    almost always   often   sometimes   almost never

11. During a reading assignment, how often do students ask about new words?

almost always   often   sometimes   almost never

12. After a reading assignment, how often do students ask about new words?

almost always   often   sometimes   almost never

13. Before a reading assignment, how often is the student given questions or directions about how this new information will fit in with what he has already learned (from this course, other courses, or perhaps on the job)?

almost always   often   sometimes   almost never

14. During a reading assignment, how often ;is the student given questions or directions about how this new information fits in with what he has already learned (from this course, other courses, or perhaps on the job)?

almost always   often   sometimes   almost never

15. After a reading assignment, how often is the student given questions or directions about how this new information fits in with what he has already learned (from this course, other courses, or perhaps on the job)?

almost always   often   sometimes   almost never

16. During a reading assignment, how often do students ask the instructor to explain most or all of what is being read?

almost always   often   sometimes   almost never

17. After a reading assignment, how often do students ask the instructor to explain most or all of what has been read?

almost always   often   sometimes   almost never

18. During a reading assignment, how often are there questions that require a memorized answer?

almost always   often   sometimes   almost never

19. After a reading assignment, how often are there questions that require a memorized answer?

almost always   often   sometimes   almost never

20. During a reading assignment, how often are there questions that require the student to interpret the information in his own words?

almost always often sometimes almost never

21. After a reading assignment, how often are there questions that require the student to interpret the information in his own words?

almost always often sometimes almost never

22. During a reading assignment, how often are there questions that expect the student to apply the new information to a problem or different situation?

almost always often sometimes almost never

23. After a reading assignment, how often are there questions that expect the student to apply the new information to a problem or different situation?

almost always often sometimes almost never

24. How often is the student given direct instruction in reading specific work-related materials, eg. blueprints, charts, code books, etc.?

almost always often sometimes almost never

25. How often is the student given direct instruction in reading specific school-related materials, eg. exams, textbooks, etc.?

almost always often sometimes almost never

26. How often is the school-related reading very different from the work-related reading?

almost always often sometimes almost never

27. How often is the school-related reading given more emphasis than the work-related reading?

almost always often sometimes almost never

28. How often is the work-related reading given more emphasis than the school-related reading?

almost always often sometimes almost never

Appendix E:2: Response to Functional Reading Questionaire

	almost always		often		sometimes		almost never	
	S	T	S	T	S	T	S	T
1.	2				1		6	2
2.	1				1		7	2
3.	2		2		1	1	4	1
4.		1	2	1	5		2	
5.	1	1	3	3	4		1	
6.	2		2		5	1		1
7.			4	2	2		3	
8.		1	2		3	1	4	
9.		1	1		1	1	7	
10.	1		2	1		2	4	1
11.	2	1	2		2	1	3	
12.		1	3		4	1	3	
13.		1	1		7		1	1
14.		1	2	2	5		1	
15.		2	3		5		1	
16.	2	1	3	1	3		1	
17.	2	1	3	1	3		1	
18.	2	2	4		3			
19.	2	1	7	1				
20.		1	1	1	4		4	
21.	1	1	1	1	2		5	
22.		1	1		5	1	2	
23.		1	6		2	1	1	
24.	3	2	2		1		3	
25.	1	1	2		1		3	
26.	2		4	2	1		2	
27.	2	1	5		1	1	1	
28.			1	1	2		6	1

APPENDIX F

READING TASKS IN DIMENSION CATEGORIES

Appendix F:1: Reading tasks in complexity categories
(based on most common positive response)

STUDENTS	INCUMBENT
1. Entire book	
textbooks trade manuals material installation procedures tool and equipment directions	
2. Part of book/text	
dictionary safety & medical warnings	textbooks trade manuals dictionary *contracts *safety & medical warnings
3. Part of book/chart	
blueprints telephone directory	blueprints telephone directory catalogue
4. 1-3 pages text	
memos work/study procedures company regulations	work orders claims memos company regulations *work/study procedures letters *contracts *safety & medical warnings
5. 1-3 page chart	
application forms schedules	purchase orders invoices application forms schedules maps material installation proced. tool & equipment directions
6. Other	
trade magazines exam questions	trade magazines *work/study procedures
7. Too varied/unclassified	
	material installation proced.

* indicates same task in more than one complexity category for same subject category

__ indicates same task in same complexity category for both subject categories

Appendix F:2: Reading tasks in frequency categories
(based on most common total response)

	STUDENTS	INCUMBENTS
1. Less than once a month	application forms schedules	*claims *application forms *blueprints *textbook *tool & equipment directions
2. Once a week to once a month	*trade magazines material installation proced. tool and equipment directions	*maps *invoices *blueprints *schedules *tool & equipment directions trade manuals *safety & medical warnings
3. 2-4 times a week	blueprints *exam questions	
4. Daily	*exam questions textbooks trade manuals work/study procedures	work orders
5. Never	*trade magazines work orders purchase orders invoices claims telephone directory maps catalogues letters company regulations contracts	*safety & medical warnings trade magazines *claims *application forms *textbook *invoices *schedules *maps dictionary catalogues letters company regulations contracts examination questions work/study procedures
6. Too varied/unclassified	dictionary memos safety & medical warnings	telephone directories memos material installation proced. purchase orders

(from Appendix F:2)
* indicates same task in different frequency category for same subject category
__indicates same task in same frequency category for both subject categories.

Appendix F:3: Reading tasks in perceived importance categories
(based on most common positive response)

STUDENTS	INCUMBENTS
1. Not important	
	*trade magazines
2. Important but not vital	
application forms	*application forms
*schedules	dictionary
*telephone directories	catalogues
dictionary	textbook
company regulations	letters
trade magazines	memos
*safety & medical warnings	*company regulations
*material installation proced.	*contracts
*tool & equipment directions	*trade magazines
3. Vital to task completion	
*schedules	work orders
blueprints	purchase orders
*telephone directories	invoices
textbook	claims
trade manuals	*application forms
exam questions	schedules
*safety & medical warnings	blueprints
*material installation proced.	maps
*tool & equipment directions	trade manuals
work/study procedures	*company regulations
	*contracts
	safety & medical warnings
	material installation proced.
	tool & equipment directions
	work/study procedures
4. Too varied/unclassified	
memos	telephone directories

* indicates same task in more than one importance category for same subject category
__indicates same task in same importance category for both subject categories

Appendix F:4: Reading tasks in general strategy categories (based on most common positive response)

	STUDENTS	INCUMBENTS
1. Reading-to-learn	blueprints textbook trade manuals safety & medical warnings material installation proced. tool & equipment directions	
2. Reading-to-do with no learning	application forms telephone directories	purchase orders invoices claims application forms maps telephone directorie
3. Reading-to-do with incidental learning	schedules dictionary exam questions work/study procedures	work orders schedules blueprints dictionary catalogues textbook trade manuals *company regulations *contracts safety & medical warnings material installation proced. tool & equipment directions work/study procedure
4. Reading-to-assess	memos company regulations trade magazines	letters memos *company regulations *contracts trade magazines

* indicates same task in more than one general strategy category for same subject category

__indicates same task in same general strategy category for both subject categories

Appendix F:5: Reading tasks in specific strategy categories
(based on most common positive response)

STUDENTS	INCUMBENTS
a. Reread/rehearse	
	work orders
	trade manuals
	*contracts
b. Problem solve/question	
blueprints	
exam questions	
c. Relate/associate	
	textbook
	*company regulations
d. Focus attention, concentrate	
(a. & d.) together	
textbook	
trade manuals	
safety & medical warnings	
material installation proced.	
tool & equipment directions	
e. Fact-finding in text	
	claims
f. Fact-finding in charts	
application forms	purchase order
telephone directories	invoices
	application forms
	maps
	telephone directories
g. Following directions using text	
h. Following directions using charts	
i. Special learning strategy	
	work orders
	trade manuals
	contracts
	textbook
	company regulations

j. Repetition over days or months	
schedules	*schedules blueprints catalogues safety & medical warnings material installation proced. tool & equipment directions work/study procedures
k. Single-trial learning	
dictionary work/study procedures	*schedules dictionary
l. Other	
m. Assess for usefulness for a particular task	
memos company regulations	memos *company regulations *contracts *trade magazines
n. Whether to read more carefully later	
trade magazines	*trade magazines letters
o. Whether to pass to someone else	
p. Other	

* indicates same task in more than one specific strategy category for same subject category

__indicates same task in same specific strategy category for both subject categories